

REPORT

—OF THE—

BOARD OF TRUSTEES

—OF THE—

Maryland ❖ Agricultural

❖ Experiment Station. ❖

—TO THE—

GOVERNOR

—AND—

GENERAL ASSEMBLY,

—FOR THE YEAR—

1889.¹

ANNAPOLIS :
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ORGANIZATION
OF THE
MARYLAND AGRICULTURAL EXPERIMENT
STATION.

CORPORATION:
THE BOARD of TRUSTEES of the MARYLAND AGRICULTURAL COLLEGE.

Agricultural (Station) Committee of the Board of
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ELMER M. DUNN,*	. . .	<i>Stenographer.</i>
W. HORACE SOPER,†	. . .	<i>Treasurer.</i>

LOCATION.

On the estate of the Maryland Agricultural College, in Prince George's County, 8 miles north from Washington.

Railroad Station, for Passengers and Freight:—College Station, Md, (on the Baltimore and Ohio Railroad, Washington Branch.)

Postoffice:—Agricultural College, Prince George's county, Maryland.

Telegraph Address:—College, Md. (Western Union Telegraph Company.)

Express Office:—College Station, Maryland, (United States Express Co.)

Address in all cases—

MARYLAND AGRICULTURAL EXPERIMENT STATION.

* Resigned, October 19, 1889.

† Died, October 25, 1889

SECOND ANNUAL REPORT OF THE MARYLAND AGRICULTURAL EXPERIMENT STA- TION, FOR 1889.

REPORT OF THE DIRECTOR.

The Weather.—In rendering “a full and detailed report of the operations” of this Station, for the year 1889, in accordance with law, the most unusual feature of the year, agriculturally, to be mentioned, is the weather; this had an important bearing upon the greater part of our operations.

Very excessive rainfall, so distributed as to involve serious deficiency in sunshine, makes a most unfavorable growing season. These were the conditions which characterized the agricultural year just passed. The following table shows that these conditions were not local:

EXPERIMENT STATION REPORT.

Places.	Normal Rainfall inches.	Rainfall 1889 inches.	Rainy Days 1889. No.
Agricu'tural College, Md.....	?	59.59	144
Baltimore, Md.....	42.97	62.25	159
Washington, D. C.....	43.69	61.33	153
Cumberland, Md.....	31.85	40.17	98

The cities of Baltimore and Washington seem to have had a greater rainfall than experienced at this Station, while Western Maryland apparently escaped the extreme. The excess in the eastern part of the State, over the average of the past eighteen or twenty years, was about forty per cent. while at Cumberland, it was but twenty-six per cent. The effect upon the growing season is better shown by the fact that the excess of rainfall in this vicinity, from April first till October first, was seventy-five per cent. At this

Station rain fell on 144 days in the year, the sun was not visible at all on 86 days out of 244 days included in this record and there was but one-third of the sunshine due according to the almanac, for this period of 8 months. The pages of meteorological records which occur later in this report include the details of rainfall and sunshine and also observations on the temperatures and the winds.

This remarkable weather interfered greatly with all of our Station work in the field, and that which is done under cover, during the growing season, is generally connected with and dependent upon the former. Tests with fertilizers and all manures are particularly unreliable in such a season and proper allowance should therefore be made in interpreting the records and results of all work of this class reported upon in the following pages. Necessary cultivation was often impossible and if finally done, it was at the wrong time; hence plant-growth was abnormal and all notes upon it unsatisfactory. A good many things which had been planned were not attempted, some experiments begun were abandoned and others were much impaired. The prevailing conditions were even more unfavorable to good results in experiment work than in practical farming. "The season" can therefore be charged with many of the failures and imperfections of this report, as well as some of its omissions. Something has been accomplished, however, as set forth in the reports of several staff officers of the Station, which follow and to which attention is invited.

In making choice of subjects for investigation at the Station, attention was early directed to the great and growing interests connected with the canning or packing of vegetables and fruits in this State, and the crops which contribute to this industry. To some of these crops it was decided to give special attention.

The Tomato.:—The tomato occupies a conspicuous place in the agriculture of a large part of Maryland. Besides the constantly increasing use of this vegetable, or fruit, in its fresh state, the demand for it for canning has become very

large. "The tomato pack" of the whole country, was estimated at 3,343,000 cases in 1888, and 2,977,000 cases in 1889. To this aggregate Maryland contributes over twenty-three per cent., or nearly one-fourth. The quantity annually canned being from thirty to thirty-five thousand tons, there must be at least forty thousand tons of tomatoes ripened yearly in this State, representing the product of twelve thousand (12,000) acres of land. Some estimates place the area and total product much higher. But the moderate figures adopted fully justify the time and attention given to the tomato at this Station, the past year, and its prominence in this report. Owing largely to the unfavorable conditions which existed, the results of this first season's work have not been conclusive in any particular. But substantial progress has been made and the tomato sections of the reports of the Horticulturist and the Chemist of the Station contribute materially to the knowledge of the subject and indicate profitable lines of further investigation. Dr. E. Lewis Sturtevant, who was for some years Director of the New York Agricultural Experiment Station (Geneva), has kindly contributed a valuable introductory chapter on the history and botany of the tomato.

A similar course of inquiry regarding sugar-corn as a canning crop was initiated but circumstances compelled its abandonment at an early period, to be renewed in a more propitious season.

Tobacco:—Maryland tobacco has long had a high reputation and this crop has been one of the staples of the State. From a combination of causes, this interest has been declining for a number of years and the acreage and average product have both seriously decreased. A large area in the State continues, as it has always been, peculiarly adapted to raising tobacco, and this comprises a section where it is very difficult to find any satisfactory substitute crop, if tobacco-growing is abandoned. Tobacco therefore seems to offer a good subject for experimental study. An effort was

made the past year in this direction, in which a number of tobacco planters of long experience and in several counties, volunteered to co-operate. Two general lines of inquiry were proposed:

I. Cannot Maryland tobacco be improved in quality?

First—By introducing new varieties of the plant; or

Second—By special feeding or other treatment of the kinds commonly raised in the State.

II. Cannot the product per acre of tobacco be increased?

First—By special fertilizers or methods of manuring; or

Second—By new or improved methods of cultivation.

Here, again, the season interfered, and the effort must be repeated to obtain any results worthy of record.

Ensilage:—Increased interest in the economies of feeding stock and the extension of dairy farming, have led many practical farmers to lately inquire into the advantages of the silo system of storing green forage and preserving it through the year in a succulent, palatable and healthful condition. To the subject of silos and ensilage, this Station has therefore given some attention during both years of its work, and the results are partially given in the report of the Agriculturist. Ensilage was first made in quantity in America and with success, by Mr. Francis Morris, in Baltimore county, Maryland, in the year 1876. It seems appropriate that further knowledge of this system should be sought at the Maryland Station and our ensilage experiments will be continued.

Variety Tests:—As shown by bulletins No. 4 and No. 5, from this Station, numerous comparative tests of different varieties of farm crops, grasses, fruits and vegetables have been made or attempted here, the past year.

The published lists contained the names of 1488 agricultural plants, claimed to represent as many different varieties and all growing on the Station grounds, during the year 1889. Besides the entire failure of a number of these trials, resulting from unfavorable weather, experience with others proved it to be useless to ordinarily do so much of

this class of work. But some of these tests have been interesting and instructive; attention is called to these records, in the appended reports of the Station Agriculturist and Horticulturist, especially as to oats, grasses and forage plants, tomatoes, potatoes, turnips, radishes and lettuce. Something of this character should be included in the yearly routine of the Station, to keep the public informed as to the merits of the new, or newly-presented varieties; but where so much land and labor are required and so little is gained, often, this work should be held within moderate limits.

Feeding Experiments:—Up to the close of the year reported upon, the facilities of this Station for conducting experiments with domestic animals have not been such as to ensure truly scientific methods and reliable results. But rather than entirely omit this class of work, some simple feeding trials have been conducted with cattle, sheep and swine. These trials are reported in Bulletin No. 7, of this Station, bearing date of December, 1889. (The general distribution of this Bulletin has been unavoidably delayed.)

Work of Verification—Potatoes:—The organic law makes it a part of the specific "object and duty" of agricultural experiment stations, to "verify experiments." The experiments at this Station with potatoes, and the general conclusions reached as to the best form of using tubers for planting, as published in Bulletin No. 2 and our first Annual Report, have been so well sustained by similar work in numerous other years and places, further confirmed at several Stations in this country the past year, that the time seems to have arrived for *verifying*, on the basis of practical farm usage and field culture, the accuracy of these experimental results, rather than continuing the multiplication of the latter. The report of the Horticulturist, which follows, contains a description of the effort, the past year, to grow potatoes at this Station, by the acre (instead of the square yard) under ordinary farm conditions but with all the facts accurately observed and recorded. This account explains

the partial failure of the attempt and gives the partial results. The latter substantially verify the conclusions of former experiments. But the vicissitudes of the potato-field of 1889 were great and this task should be repeated. The year's experience is sufficient, however, to prove the need and value of this work of verification.

Co-operation.—As the national system of agricultural experimentation becomes established, the expediency of systematic co-ordination and co-operation between Stations in neighboring States, demonstrates itself to all engaged in the work. Much of the work of the Pennsylvania Station applies equally well to our central counties and the northern tier; the West Virginia Station is engaged upon problems and laboring under conditions very similar to those of Western Maryland and the work which the Delaware Station elects for its State, is well suited to the Eastern Shore.

It was the purpose of the Delaware and Maryland Stations to co-operate during the past year in experiments with forage plants believed to be specially adapted to the Delaware-Maryland peninsula, but circumstances necessitated a postponement of this work. It is believed that something of this kind can be done in the future, to our mutual advantage.

Upon the invitation of the United States Department of Agriculture, this Station co-operated with certain Divisions of that Department, during the season of 1889, in promoting three lines of investigation:

1. Special feeding of cows and making butter from them, to ascertain the effect of peculiar food upon the composition of butter.

2. Growing sorghum in great variety and considerable quantity, under different conditions, as an adjunct to the sorghum-sugar experiments by the Chemist of the Department.

3. Raising mulberry trees of different kinds for the information and use of the Silk-section of the Division of Entomology.

Marls and Soil Examinations:—The Act of Congress making the appropriation which supports this Station during the year ending June 30th, 1890 contains a special proviso that “a portion of the work of the Station shall be devoted to the examination and classification of the soils of the State, with a view to securing more extended knowledge and better development of their agricultural capabilities.” In accordance therewith a number of examinations have been made of peculiar and of characteristic soils in different parts of the State, and the investigation of the marl deposits of the Eastern portions of Maryland, has been renewed. Full descriptions of the samples taken and the results of their chemical analyses are given in the report of the Station Chemist. This work will be continued and particularly that part of it relating to the marls.

Maryland marls have been studied at intervals, under the auspices of the State, with a view of determining their economic relation to agriculture. In 1833, Prof. J. T. Ducatel was appointed State Geologist and commenced the work of making a geological survey and map of Maryland, being assisted by J. H. Alexander, as engineer, and others. The reports of Ducatel were rendered annually and published by the State from 1834 to 1840, inclusive. The second and third of these reports are almost wholly given to the marl beds, their location, character of deposits, chemical composition, methods of excavation and the use of marl on farms. Later reports include special notes upon the geology of the several counties of the State, with relation to their agricultural needs and capabilities. This important work was permitted to lapse in 1841. Six years later, under an Act of Assembly, Dr. James Higgins, was appointed State Agricultural Chemist and his first report to the Legislature was published in 1850; subsequent reports of this officer were printed by the State in 1852, '53, '54, '56 and '58. In all of these reports much attention is given to the soils of the State and especially to the marl deposits. The Assembly ordered 10,000 copies of Higgins' first report for general

distribution and the demand for these documents became so great, all over the State, that the number was increased year after year, till an edition of 22,000 copies of the Sixth Report was ordered, in January, 1858. In May, 1858, Prof. Philip T. Tyson succeeded to the position and duties of State Agricultural Chemist. Two reports by Tyson were published by the State, in 1860 and 1862, respectively, and then his work ceased. These reports also contain much of value regarding the geology, the soils and the marl deposits of the State. The advancement of science aided this line of work, and the labors of Prof. Tyson, although twenty years have since elapsed, may be regarded as the most intelligent, comprehensive and useful of their kind yet performed in the State and for its benefit. Prof. P. R. Uhler, president of the Maryland Academy of Sciences, has lately pursued a geological study of the tidewater portions of the State, and added valuable contributions to previous knowledge of the marl deposits.

A good foundation has thus been laid for the further investigation of Maryland marls. Indeed little more is needed than to re-locate the chief deposits, gather together what is already known about them, and again determine their composition and relative merits as fertilizers, with such new light as modern science lends to the work. The economic use of the best of these marls must also be reviewed with reference to the changed condition of labor and agriculture generally. In taking up this work, the Station has promise of the active and efficient aid of a division of the U. S. Geological Survey.

Seed Examinations:—During the early spring of 1889, the Horticulturist made an extended and detailed examination of the seed supply of the State. The local Granges of the Patrons of Husbandry assisted in procuring samples of seed and the necessary information as to the sources of supply. This inquiry was applied mainly to seeds for gardens and truck farms, although more or less farm field seeds were also included. It was found that the bulk of

garden and vegetable seeds, sold in the State, are supplied by the following named dealers and growers: D. M. Ferry & Co., David Landreth's Sons, Peter Henderson & Co., Buist of Philadelphia, and Bolgiano of Baltimore. The samples were in all cases taken directly from the stock offered for sale. They were examined with reference to their purity and vitality, and some were grown to determine trueness to name. The work involved a great deal of detail, and the records include a mass of figures of countings and weighings, with many other notes. It seems quite useless to publish these extensive and uninteresting tables.

The general result of this examination was to furnish conclusive proof that the supply of vegetable and garden seeds offered for sale in the State is good, satisfactory in quality and reasonable in quantity for the prices. Only in exceptional cases were seeds found impure or lacking in vitality or germinative power. The general freedom from impurities show that, as a rule, proper care is taken in cleaning the seed before it is offered for sale. This statement does not include field seeds. Grass and clover seeds were found to often contain much foreign matter, partly worthless and partly injurious. But the sources of supply of this class are generally unknown, the lots are very numerous and vary greatly, and by the time a sample can be obtained and properly examined, the lot it represents is likely to have changed ownership and be untraceable; hence this line of work affords little of practical value besides general information. The average of germination for samples tested, of all classes, was over 75 per cent. There was a marked difference in the vitality of different kinds of seeds; for instance, lettuce seed has always a very high rate of vitality (94 per cent. or over), while carrot and cauliflower seed are usually of low vitality (ranging from 53 to 64 per cent). Cauliflower seems to be the most expensive of all garden seeds, especially in the packet form. A certain packet of Snowball Cauliflower was found to contain only 344 seeds, a third of these worthless, and yet

at the packet-price paid, this seed cost eighty-four (\$84) dollars per pound!

Improvements at the Station:—Substantial progress has been made during the year, in providing facilities for the peculiar work of the Station. The library has been increased, important additions have been made to the laboratory equipment, microscopes and accessories have been purchased and a complete photographic outfit obtained, including the fitting up of a suitable darkroom.

A commodious and well-arranged building for stable and storage has been erected, forty feet square, with sixteen-foot posts and a hipped roof, giving great capacity in the lofts. On the first floor are stalls for the working animals, harness room and feed room, all on the north side; on the south side are four boxes or pits, ten feet square, with water-tight bottoms and sides, for feeding experiments, and for making and saving manure for special purposes. Each of these boxes has a window and an outer door; also a door opening upon the central space where a platform scale of two tons capacity is set in the floor. The second story is well-floored and well-lighted. This floor and the lofts above are for general storage, but arranged with special reference to separately storing the crops from field plots comparatively small and numerous. The funds available were exhausted before this building was painted on the exterior, or quite completed inside. The legal allowance of five per cent. of the annual income, for erection, alteration and repairs of buildings, is insufficient during the formative period of the Station and the limit should be doubled.

Quite an extensive system of draining a portion of the experiment lands has been planned, some of the mains have been laid and the tile are now upon the ground for about two miles of lateral branches.

Needs of the Station:—As soon as circumstances permit, a roomy shed, fifty or sixty feet long, should be built adjoining the new out-buildings on the north, to cover a

tool-room and carriage-house, and give ample storage for wagons, farm implements, fertilizers, manure and composts made under cover. A small plant-house is also needed to enable botanical studies to be continued throughout the year. A good deal of work is required to complete the fitting of the room in the main building, reserved for a museum, and supply it with cases, etc., while the seed-room and the shop are lacking in equipment.

Farm Mechanics.:—It is intended to follow the progress of mechanics as applied to farming operations, and from time to time, as opportunity permits, to make practical and, in some instances, comparative trials of new and improved implements and machinery. The object will be to test their efficiency and make impartial reports upon their merits and defects. A beginning has been made in this direction and the brief records will be found in the appended report of the Machinist of the Station.

Exhibitions and Meetings.:—The policy of making the Station and its work known to the people of the State, through the agency of agricultural shows and public meetings, as explained in the First Annual Report, has been continued during the past year, with increased satisfaction. The Station has made exhibits, in the nature of object lessons, at every County Agricultural Fair held in the State during the past autumn, as well as at the Exposition of the State Association at Pimlico. Members of the Station staff, assisted by students of the senior class of the College, were in attendance in all cases to explain the exhibits, distribute bulletins, and give information regarding the Station and its purpose. These displays attracted much attention and were favorably commented upon. At the Talbot County Fair, a special committee, strong in its composition, made an examination of the Station exhibit there and reported upon it in terms of high commendation. Useful and appreciated as this work has been, it has proved very laborious and expensive and occurs at a time of year when there is much to be done at the Station. It seems well,

therefore, not to attempt so much of it hereafter, in any one season, but visit three or perhaps four counties each year, in different parts of the State, not going to the same county two successive years.

The most extensive exhibit made by the Station was at Pimlico. A floor space, 50 by 20 feet, was assigned and the display occupied 300 square feet of table and 800 feet of wall space. The exhibit embraced 24 varieties of corn, 30 of wheat, 28 of oats, 30 of potatoes, 50 of tomatoes, 18 of squashes, 15 of beans, 12 of peppers, 10 of tobacco, and collections of grasses, forage plants and sorghum. There were also object lessons in the chemistry of food products, showing the component parts of a stalk of corn, a peck of wheat, a peck of potatoes, and a gallon of milk. The exhibit was carefully prepared and tastefully arranged so as to be both instructive and attractive in its appearance. For example, the 28 varieties of oats were shown side by side, and of each variety there was a tray containing two quarts in merchantable form, on a table within reach of the visitor; behind the tray a show-bottle of extra cleaned seed; hung on the wall back of these, a sample sheaf of the crop as harvested, and above this a single complete plant representative of the variety, washed out, showing its rooting and tillering habits; attached to the sheaf was a large card giving the name of the variety, the source of the seed, the average height of plant, the product of grain per acre, and the weight of a measured bushel. The data were thus afforded for an intelligent and comprehensive comparative study. The other parts of the exhibit were similarly arranged and accompanied by explanatory cards.

The Director of the Station and his assistants have also continued, as opportunities have occurred, to attend meetings for the discussion of agricultural subjects, in various parts of the State, and during the past year such duties have been performed in eleven different counties. The Association of American Agricultural Colleges and Experiment Stations, has formally declared in favor of this kind

of work by Station men, and it is certain that the direct intercourse which is thus secured between the practical farmers of the State and the officials of the Station materially assists in turning the labors of the latter in the right direction and enhancing the value of their results.

Visitors.:—The very best way in which to have the objects, facilities and operations of the Station known to those for whose special benefit the institution is maintained, is by inducing as many people as possible to come here and see for themselves. Special effort is made to have it well known that visitors are always welcome and will be given every possible attention. This is having its effect and, as time passes, more and more visitors are coming. Committees or larger delegations from agricultural organizations of all kinds are now frequently to be found here, making careful examination of the workings of the Station. Within the year, representatives of nearly all the prominent organizations in the interest of farming, have been here. The Maryland State Farmers' Association and the State Grange have both appointed standing committees to inspect the Station and its work, and periodically report upon its condition and management. Visits from progressive farmers individually interested in the work are also becoming frequent.

Reports and Bulletins.:—The law establishing the Station for the purpose of "acquiring useful and practical information on subjects connected with agriculture," requires that this information shall be *diffused among the people* and prescribes methods of so doing, chiefly by publications. The publications of this Station during the past year have been:

The First Annual Report, issued in January, 1889, and the following Bulletins, or "reports of progress," viz.:

No. 4, March—The Experiment Orchard.

No. 5, June—Horticultural Department and Field Experiments.

No. 6, September—Commercial Fertilizers.

No. 7, December—Feeding Experiments.

Special Bulletin.—Facts about the Station, for distribution at the agricultural fairs, the use of visitors, etc.

Owing to unforeseen circumstances delaying these issues, Nos. 6 and 7, of the Bulletins, have not at this writing, been generally distributed.

Editions of four to ten thousand of these publications have been distributed, mainly by mail to individuals desiring them. All have been issued in uniform style and consecutively paged, and this report will conform to the same as closely as possible, although paging now begins anew.

The law provides that the publications of the Station shall be sent free of postage, through the mails, to all newspapers in the State, and “to such individuals actually engaged in farming as may request the same.” This quoted restriction does not apply to the annual report. It is probable that, for the present, the Station will be able to send its publications to all who ask for them.

The printing of the Reports and Bulletins of the Agricultural Experiment Stations in most of the States is now done like other public documents. The principle has been generally accepted that, as the Federal government provides all cost of obtaining and formulating the “useful and practical information” of the Station, and permits of its free passage in the mails, the State should assume the mere expense of publication. It is hoped that this subject will receive the consideration and affirmative action of the General Assembly of Maryland. The distribution of this report awaits such action. Attention is invited to the large editions of the annual reports of the State Agricultural Chemist, which were published in former years by order of the General Assembly, as already mentioned, and the eagerness with which those pamphlets were sought by the people of the State interested in the subjects therein presented.

Correspondence.:—In the first bulletin issued by the Station, and also in its first annual report, it was stated

that the Station officers desired to be in direct communication with citizens interested in the work. Correspondence has resulted which is increasing in quantity and variety and already forms a large part of the office work of the Station. Cheerful and generally prompt attention is given to all communications received. During the twenty months which this Station has been in active operation, there have been received 1,542 letters ; all of these have been answered, besides postal cards and circulars sent out by the hundreds, of which no exact records have been made.

Conclusion.:—I desire to express my thankful appreciation of the cordial support received from the Board of Trustees, for the faithful, intelligent and efficient services of staff officers of the Station, and for the patient interest, kindly criticism and substantial encouragement shown by many hundreds of farmers and landowners in all parts of the State.

HENRY E. ALVORD, Director.

THE TOMATO.

By DR. E. LEWIS STURTEVANT.

There are very many living in our country to-day who never either ate or knew the tomato in their boyhood, for the general use of the tomato was unknown in 1830. Indeed about this period as an esculent plant the tomato was almost detested, (1) and our mothers knew it by the name of the love apple, and warned against its eating as poisonous. We find, however, notice of its being grown for cooking purposes as early as 1781 in Virginia (2) and again by Varlo in his book on Husbandry, in 1785. M'Mahon, in 1806, in his treatise on American gardening, says the tomato is in much estimation for culinary purposes. It is enumerated for American gardens by Gardiner & Hepburn in 1818, by the Practical American Gardener, Baltimore, 1819, by Fessenden, 1828, and Bridgeman in 1832, but in these cases it is probable that the fruit was only used in sauces and pickles. We have record, however, of its introduction into Salem, Mass., about 1802, by an Italian, who grew it but found it difficult to persuade people even to taste the fruit (3). It is said to have been introduced into Philadelphia by a Frenchman from St. Domingo, in 1798 (4), but it was not sold in the markets until 1829. In Boston, as late as 1835, they were sold by the dozen in Quincy market (5). In Western New York they appear to have been first grown as a vegetable in 1825, brought to Rochester from Virginia (5½). In New England, in 1832; they were often grown only as curiosities (6) although it was understood that the French ate them. In New Orleans, in 1812, they are said to have been in use as a food by the French population (7). It is only in 1844 that the

(1) White Gard. for the South p. 312. (2) Jefferson, Notes, Trenton, 1803, p. 55. (3) Felts. Annals of Salem, ii., 631. (4) Prairie Farmer, June 28, 1876

tomato was acquiring that popularity which makes them now so indispensable to our gardens (8); and D. S. Brown, an excellent authority, says the tomato was almost wholly unknown as an esculent vegetable in 1834 (9).

I find the first mention of the tomato in Europe by Matthioli in 1554 (10), who in his Commentaries on Dioscorides says that it was beginning to be imported into Italy, and was popularly called *Pomi d'oro*, that is *mala aurea* (golden apple). He remarks that they are eaten. In 1583, Dodonaeus (11) indicates their presence in Italian, German, Belgian and French gardens, and says that some eat them cooked with pepper, salt and oil, but he gave them no praise. In 1587, Gerarde (12) had them growing in his English garden, but he does not seem to have tested their edibility, for he but mentions their being eaten boiled with pepper, salt and oil, or raw as a sauce, in Spain.

The tomato is a native Mexico and tropical America, and was carried to Europe and Asia, where it appears to have been adopted as a food earlier by the Southern than by the Northern nations. We now have very numerous varieties, but with few exceptions, the types of all are to be recognized in the earlier figures and descriptions, and we may reasonably state that there is no indication of any new varieties of distinctive character having originated in our modern culture. The only exception, I know of, is the variety called the Peach, and as yet its origin has not been sufficiently studied to entitle it to being considered an exception to the general statement. Professor Bailey who has devoted considerable attention to the species, assigns all our cultivated forms to two originals, *Lycopersicum cerasiforme* and *L. esculentum*. The various forms which occur may find popular classifications in the spheroid, the oblate smooth, the oblate ribbed, the oval, and the pear shaped. The col-

(5) Am. Gard. May, 1835, 437. (5½) Autobiog. of Thurlow Weed. (6) T. S. Gold, Sec'y Conn. Bd. of Ag, in private letter. (7) Prairie Farmer, I. c. (8) Hist. Mass. Hort. 8 v1., 269. (9) Pat. Of. Rept. 1854, 384. (10) Matth. Comm. 1554, 479. (11) Dodon. pempt. 1583, 455, fig. (12) Gerarde, Herbal. 1597, 275, fig.

ors, red, purplish red, yellow and white. Let us consider how long these forms and colors have been known.

The name *mala aurea* or golden apple, as used by the older commentators would indicate that the yellow form was the more prevalent in the early importations. Indeed, Matthioli in 1554, mentions the yellow first, justifying this conclusion. The description is sufficiently accurate to indicate that the first importations into Italy were of the yellow and red oblate ribbed form now so common with us. As to colors, the golden yellow is named by Matthioli as above stated, the ochre yellow by J. Bauhin (13) in 1651, and deep orange by Bryant (14) in 1783. The red is noted by Matthioli in 1554, the pale red by Tournefort (15) in 1700, and the purple red by Pena and Lobel (16), in 1570. The white-fruited is named by Dodonaens (17) in 1586, and by Bauhin (18) in 1596. We may also note that a versicolored fruit is described by J. Bauhin in 1651, and the bronze leaved is indicated in Blackwell's Herbarium, 1750, t. 133.

The ordinary form with flattened and more or less ribbed fruit seems to have been the first introduced. It was probably the kind first mentioned in 1781 as cultivated in the country, and was certainly the kind whose introduction into general culture is noted from 1806, onward. We offer for this form the following synonyms gained from figures:

Poma amoris, an *Glaucium* Diosc. Lob. obs. 1576, 140.

Poma amoris, Cam. epit. 1586, 821; Ger. herb. 1597, 275.

Sweet florileg. 1654, t. 20, f. 2.

Poma amoris, *pomum aureum*. Lob. ic. 1591, i. 270.

Solanum pomiferum, fructu rotundo, molli. Matth. oper. 1598, 761.

Poma amoris fructu luteo et rubro. Hort. Eyst. 1613.

Aurea mala. Dod. pempt. 1616, 458.

Pomi d' oro. Cast. Dur. 1617, 372.

Great apple of love. Park. par. 1629, 379.

(13) J. Bauhin, Hist. 1651, iii., 620. (14) Bryant, Fl. Diet. 1783, 212. (15) Tournefort, Inst. 1700, 150. (16) Pena & Lobel. Adv. 1570, 108; 1576, 108. (17) Lyte's Dodonaens, 1586, 598. (18) Bauhin, Phytopin. 1596, 302.

Amoris pomum. Blackw. 1750, t. 133.

Mala aurea. Chabr. 1677, 525.

Lycopersicon. Tourn. 1719, t. 63.

Morelle pomme d'amour. Descourt. 1827, VI. 95.

Tomato rouge grosse. Vilm. 1883, 555.

The round or oval unribbed varieties which have become popular in recent years, apparently came into use after the ribbed forms. In 1700, Tournefort places among his varieties the *Lycopersicum fructu rubro non striato*, and the same variety was catalogued by Tilly (19) at Pisa, in 1723. In 1842, some seed of a Feejee Island variety was distributed in Philadelphia, and Wilkes (20) describes the fruit of one variety as round, smooth, yellow, the size of a large peach. The Large Smooth or Round Red, and the Small Yellow oval tomato of Brown (21) may belong here. Here may be classed such varieties as Hathaway's Excelsior, King Humbert and the Plum, as well as some of the *tomate pomme* varieties of the French. This form occasionally appears in the plants from seed of hybrid origin, as when a cross was effected between the currant and the tree-tomato.

Mere size does not necessarily constitute a botanical difference. Thus the Hubbard squash is usually small, and so also is the Marrow. Yet at the Bay State Fair in Boston in 1889, two squashes were exhibited labelled *mammoth* and weighing approximately 80 or 90 lbs. each, or more, and which were unmistakably of the form and color and markings of these named varieties. Thus the round tomatoes, although larger, may be considered but as cultural varieties of the Cherry-tomato, *Lycopersicum cerasiforme*, Dunal.

The cherry tomato is recorded as growing spontaneously in Peru (22), the West Indies (23), the Antilles (24) and Southern Texas (25), and I have also noted it as an escape along a railroad cutting in New Jersey. It was noted in

(19) Tillius. Cat. 1723 102. (20) Wilkes. U. S. Exp. Exped. iii., 3335
(21) Brown, U. S. Pat. Of. Rept. 1854, '85.

Europe by Bauhin (26) in 1620, the red fruited. It is mentioned by Bryant (27) as the only sort in general culture in England in 1783, but Mawe in 1778 enumerates the large Red, as also the red and yellow cherry as under garden culture. The following is its synonymy:

Solanum racemosum cerasorum forma. Bauh. prod. 1620, 90: pin. 1623, 167.

Solanum amoris minus, etc. Park. par. 1629.

Cujus fructus plane similis erat, magnitudini, figura, colore.

Strychnodendro, etc. Recchufis. Hernand. Mex. 1651, 296.

Fructus est cerasi instar (quoad magnitudini). Hort. reg. bles. 1669, 310.

Solanum pomiferum fructu rotundo, molli parvo rubro plano. Ray. hist. 1704, iii. 352.

Lycopersicum fructu cerasi rubro. Tourn. 1719, 150 'luteo, ib.

Solanum lycopersicum. Bryant. 1783, 212.

Cherry fruited. Mawe, 1778.

Cherry. Mill. dict. 1807; Burr Gard. veg. 1863, 649-652.

Morelle cerasiforme. Descourt. Ant. 1827, V. 279. t. 378.

Tomate cerise. Vilm. 1883, 559.

The pear shaped or fig tomato exists in yellow, pale yellow or whitish, and red fruits. It was first described by Dunal, and is given in Persoon's Synopsis of 1805. It is mentioned in England in 1819, and both the yellow and red in the United States by Salisbury (28) in 1848. It seems to have no other recorded history.

The Peach tomato, of recent introduction, is remarkable for the roughness of the skin, which gives to it the appearance of a peach. Professor Bailey considers it as a variety of the cherry tomato. He informs me that it differs some-

(22) Dunal. Solan. III. (23) Sloane. Cat. 1696, 109. (24) Descourt. Pi. Ant. V. 279. (25) Gray. Syn. fl. ii. 226. (26) Bauhin prod. 1620, 90. (27) Bryant. fl. dict. 1783, 212.

what in habit of growth from the cherry tomato, being more upright, and the foliage lighter colored. It seems to have no recorded history.

The Currant tomato is occasionally grown for pickling. It grows wild in Brazil, and was described by Linnaeus in 1763. The red fruit somewhat larger than the common currant (*Ribes*) grows in two ranked racemes, often very long and abundantly filled. It enjoys a specific rank, being the *Lycopersicum pimpinellifolium*, Dun.

The tomato has been under cultivation from a remote period by the Nahua and other Central American nations, and reached European and American culture, as the evidence implies, in an improved condition. So far as we can infer from published records, there has been little or no gain in quality through modern effort. Some of the figures given in works published before the tomato came into American use as an esculent, indicate fruits as large and as smooth as any that we now grow. That we have gained in flavor, prolificacy and earliness may be claimed, as being within the region of probability, and as being claims that are difficult to disprove. From the large number of varieties now separated we have excellent field for choice. At the New York Agricultural Experiment Station in 1887, sixty-four sorts were described, yet all may be referred to the few types we have indicated.

The various so-called species of the tomato cross with facility. In a paper read before Section F, of the A. A. A. S. at the Ann Harbor meeting, and published in the American Naturalist for November, 1885, I give some particulars of certain crosses. These facts indicate that through the encouragement of atavism through crossing the most opposite types, we have it in our power to regain successful attempts of our forefathers, and secure a line of plants from which judicious choice and effort can segregate whatever forms we may select. Through crossing of plants ob-

tained from different countries, we may thus reproduce varieties that have once been used there, and thus a single plant from Mexico, for illustration, may be forced to grant for our service all Mexican varieties which have secured general recognition there. It is very possible that the curious peach tomato, or yet earlier in time, the plum or fig tomato, was secured by voluntary or involuntary crossing of varieties, one at least of which came from a region where these tomatoes were known. It is well for our experiment stations to recognize that atavism as a force is capable of being brought into service.

Although it is probable that modern botanists will ultimately refer all our known tomatoes to two varieties, the *L. cerasiforme* and the *L. pimpinellifolium*, yet at various times several forms have been described as distinct, and have received specific names. The list may be of interest:

1. *Lycopersicum pimpinellifolium*, Dun. The currant tomato native to Peru and Brazil, very prolific and of excellent quality but small. *Solanum pimpinellifolium*, L. sp. 1762, 265. Willd. sp. 1797, i. 1033.
2. *Lycopersicum esculentum*, Dun. The first tomato introduced into European and American culture, its record dating from 1554.
3. *Lycopersicum cerasiforme*, Dun. Recorded in culture in Europe in 1620; probably the species to which all the others but No. 1, will ultimately be joined.
4. *Lycopersicum pyriforme*, Dun. Has no claims to specific rank.
5. *Lycopersicum Humboldtii*, Dun. A species wild in South America, and cultivated in Venezuela. It was grown in Europe in 1829, apparently unknown at the present day to European or American botanists.

The classification of species adopted at the New York Agricultural Experiment Station in 1887, in describing the varieties was:

1. *Lycopersicum pimpinellifolium*.

2. *Lycopersicum esculentum*.

var. a. cerasiforme. 1, Red fruited: 2, Yellow fruited.

b. vulgare. 1, Red or purplish fruit:

2, yellow or orange fruit: 3, white fruit.

sub. var. Grandifolium.

sub. var. Validum.

var. c. Oblongum. (*L. pyriforme*, Dun.)

REPORT OF THE HORTICULTURIST.

BY WM. H. BISHOP, B. S.

I. VARIETY TEST WITH TOMATOES.

Believing that the large canning and truck-growing interests in this State would be benefitted thereby, a somewhat extended line of work with the tomato was inaugurated at this Station the present season.

It was our endeavor to test all of the more recently introduced "novelties" of the seedsmen. Sixty-six samples of seed, under sixty different names, were procured, including several well known old sorts, for comparison.

The seed was planted in the hotbed March 15th, most of the varieties had vegetated by the 28th of the month and on April 15th, the young plants were set four inches apart in a cold frame, and protected either by glass sash or by frames covered with "plant-bed cloth," until they were ready to "harden," previous to setting in the field.

Two days before they were to be set out, the roots were cut between the rows by running a grass knife between them one way, to a depth of about four inches, and when set in the field, many of them barely showed signs of wilting.

The land upon which they were to grow, was light clayey loam mixed with gravel. A crop of cow-peas had been grown and plowed under in 1888, and early in May, 1889, a crop of rye was plowed in. A fertilizer was prepared by mixing the following ingredients in the proportions named: Dried Ground Fish, 833 lbs; Dissolved Bone Black, 210 lbs; Muriate of Potash, 150 lbs. This made a "complete" fertilizer having 5 per cent. Nitrogen, 10 per cent. Phosphoric Acid and 8 per cent. Potash. It was applied at the rate of 1000 pounds per acre, broadcasted and harrowed in.

Twelve plants of each variety were set $4\frac{1}{2}$ feet apart each way.

A few of the least important varieties, from a commercial standpoint, we were obliged to set on land previously prepared for other crops, as the area allotted to tomatoes proved to be too small, some varieties being received after the apportionment of land was made. The names of these varieties are marked in Table I, and their yields should not be strictly compared with those of the others. (For Table I, see pages 28, 29 and 30.)

No training or trimming of the plants was at any time resorted to and the plot was simply kept clear of weeds by ordinary cultivation.

The fruit began to ripen July 8th, and all ripe fruits were packed twice a week from that date until September 2nd, and then once a week till the last picking on October 5th, when the green fruits still remaining on the vines, were also picked. The bearing season thus extended over nearly three months.

At each picking all the tomatoes from the twelve vines of each variety, were counted and weighed, and at the last picking, the green fruits were also counted and weighed.

It does not seem necessary or desirable to publish in detail, the mass of figures thus obtained. For the present record, the bearing season has been divided into three periods representing the early, main, and the late crops, respectively, each period consisting approximately of one month.

The first double column, giving the yield to August 1st, inclusive, the date of the last picking in that period, shows the comparative earliness of those varieties which first came into bearing.

In forming opinions upon the respective merits of the different varieties, we must continually bear in mind that duplicate trials of the same variety rarely give like results. Therefore, if a certain variety gives a higher yield than

[Text continues on page 32.]

821	Favorite	Liv.....	11	80	219	1358	188	692	418	2130	15	25	11.93	598	5.10
822	Gen. McClellan	Cowan	6	50	129	1063	104	702	239	1815	10	15	10.17	339	7.60
823	Golden Trophy†	Cleve.	4	16	329	968	165	373	498	1552	70	75	7.57	252	2.71
824	Golden Queen†	Liv.	6	21	276	1339	136	323	418	1683	16	25	9.43	314	4.03
826	Hundred Day	Thor.	63	180	319	867	57	111	439	1158	35	41	6.48	216	2.64
827	Imp. Large Yellow†	"	4	10	244	449	418	640	666	1099	52	48	6.15	205	1.65
828	Ivory Ball	Land. ....	.....	.....	487	594	384	455	871	1049	59	38	5.87	196	1.20
829	King Humbert†	Thor.	19	36	491	971	245	319	755	1126	48	42	9.08	303	1.50
830	Large Yellow†	"	19	60	375	788	113	149	507	997	.....	.....	5.58	186	1.96
831	Lorillard	Cowan	12	44	264	1128	190	593	466	1765	26	23	9.89	330	3.79
832	Matchless	Burp.	6	18	182	1072	204	654	392	1744	26	28	9.77	326	4.55
833	McCollum's	McCul.	13	47	179	789	218	819	410	1655	123	232	9.27	309	4.11
834	Mikado	Hend.	11	81	161	1117	111	706	283	1903	33	117	10.66	355	6.72
835	Mikado	Thor.	3	13	164	1351	162	1112	329	2476	23	55	13.87	462	7.52
836	Morning Star	Salz.	16	98	241	1496	223	1033	480	2627	61	148	14.71	490	5.39
837	New Jersey	Thor.	6	41	205	1306	214	858	425	2205	51	100	12.35	412	5.19
838	New Queen	Cleve.	23	119	442	2142	274	846	739	3107	75	115	17.40	580	4.20
839	New White Apple†	Thor.	12	14	503	572	466	511	881	1097	36	24	6.14	205	1.24
840	Optimus	Ferry	16	91	392	1435	226	635	634	2161	65	94	12.10	403	3.40
841	Paragon	Liv.	13	61	239	1312	285	1042	537	2415	35	64	13.53	451	4.50
842	Paragon	Hend.	2	10	253	1238	192	744	447	1992	46	90	11.16	372	4.45
843	Peach†	Burp.	47	59	693	950	850	820	1390	1829	173	128	10.24	341	1.15
844	Perfect Gem	Salz.	7	47	216	870	200	590	423	1607	77	93	9.00	300	3.80
845	Perfection	Liv.	16	87	259	1159	157	487	432	1732	38	55	9.70	323	4.00
846	Potato-leaf	"	9	41	214	886	150	483	367	1410	48	65	7.89	263	3.84
847	Prize Belle	Buist	17	82	236	1105	246	846	469	2033	57	84	11.39	380	4.07
848	Prize Belle	Maule	16	68	204	881	235	790	455	1739	80	152	9.74	325	3.82
849	Puritan	Thor.	20	102	373	1910	307	1019	700	3032	98	62	16.98	566	4.62
850	Scoville	Burp.	23	129	412	2082	258	718	693	2919	101	207	16.35	326	4.21
851	Red Apple	Ferry	24	125	317	1194	139	328	480	1745	69	90	9.77	545	3.63
852	Station†	Maule	1	23	1	13	31	70	33	47	83	164	.42	14	2.25

TABLE No. I.—CONCLUDED.

Garden No.	Name of Variety.	Source of Seed.	Ripe Fruit Picked from						Total Yield of Ripe fruit.		Green Fruit Picked Oct. 5.		Yield of Ripe Fruit per acre.		Average Wt of single Fruit in ounces.
			July 8, to Aug. 1.		Aug. 5, to Sept. 29.		Sept. 2, to Oct. 5.								
			No.	W't in oz.	No.	W't in oz.	No.	W't in oz.	No.	Oz.	No.	Oz.	In Tons.	Bush. 60 lbs.	
853	Sunrise Yellow†	Hend.	4	18	164	729	122	351	290	1098	.....	.....	1.62	54	3.79
854	Shah†	"	8	33	108	662	31	119	137	514	.....	.....	2.88	96	3.50
855	Tree†	Ever.	6	26	114	406	83	262	203	694	22	36	3.89	130	3.42
856	Tree†	Maule. ....	.....	.....	.....	.....	9	30	9	30	44	81	.17	6	3.33
857	Trophy*	Thor.	30	154	284	1754	123	615	437	2522	83	180	15.41	514	5.77
858	Turner Hybrid.	Maule.	17	157	234	1989	128	752	379	2898	60	155	16.28	543	7.64
859	Turner Hybrid.	Burp.	14	90	217	1848	114	521	345	2459	54	144	13.77	459	7.13
860	Volunteer.	"	41	229	388	2052	119	433	548	2724	60	124	15.26	509	4.97
861	Haine's No. 64.	N. B. & Co..	40	193	346	1636	169	557	555	2392	77	132	13.40	447	4.31
862	Fire King°	Buck.	29	100	361	977	168	398	558	1475	59	56	8.26	275	2.64
863	Ignotum°	Mich. A. Col.	.....	.....	108	780	226	1143	334	1923	75	146	10.77	359	5.76
864	Wonder of Italy°	Pearce	4	3	352	358	175	92	531	453	.....	.....	2.53	84	.85
865	Early Puritan°	Ag. Dpt. U.S.	.....	.....	168	867	279	1057	447	1924	71	127	10.78	359	4.30
866	Fulton Market†	Ag. Dpt. U.S.	.....	.....	162	753	154	606	316	1579	40	59	8.81	295	5.00

* (No. 863, -10 plants) (No. 829, -9 plants) (No. 857, -11 plants)

° The seed of these varieties was received so late as to necessitate planting from one to four weeks later than the rest. This fact should be borne in mind in comparing the yields.

† These varieties not being on land prepared in the same way as that for the others, should not be compared closely with the main list.

TABLE NO. II.

No.	Name of Variety.	Source of Seed	Yield Previous to			Total yield ripe fruit Ounces.	Aver. size of fruit. Ounces.	Per cent. of flesh.	No. of seed per gram of fruit.
			Aug. 1. Ounces.	Aug. 29. Ounces.	Oct. 5. Ounces.				
828	Ivory Ball*	Land....	.....	594	455	1049	1.20	.72	2.704
839	New White Apple*	Thor....	14½	571	511	1097	1.24	.73	2.393
834	Mikado	Hend....	81	1117	706	1903	6.72	.82	1.131
835	Mikado	Thor....	13	1351	1112	2476	7.52	.82	1.162
841	Paragon	Liv....	61	1312	1042	2415	4.50	.72	1.486
842	Paragon	Hend....	10	1238	744	1992	4.45	.75	1.382
847	Prize Belle	Buist....	82	1105	846	2033	4.45	.76	1.686
848	Prize Belle	Maule....	68	881	790	1739	4.07	.73	1.257
858	Turner Hybrid	Maule....	157	1990	752	2898	3.82	.78	1.323
859	Turner Hybrid	Burp....	90	1849	521	2459	7.64	.92	.962

* Ivory Ball and New White Apple are placed in this table because they are the same variety under different names.

another, in this season's test, it does not follow that it will always do the same under all circumstances.

As showing the wide variations that may occur in the same variety under like conditions we give Table No. II as a check to the too hasty formation of opinion upon the bearing and other qualities of the varieties in the above list. (For Table II, see page 31.)

Since the same variety from different sources, may give such widely varying returns, it is certainly reasonable to suppose that so-called different varieties, which in appearance are so nearly alike as to be indistinguishable one from another, whether from the same or different sources, may also give widely divergent results.

Although all the figures given in this table are presented elsewhere, we bring them together here for convenient reference and to illustrate this point.

With a view to learning some facts that would be of value in studying methods of improving the varieties of the tomato, as well as giving us knowledge concerning the physical characteristics of varieties, examinations of more than 600 specimens were made in the following manner. The special points under consideration were the number of cells per fruit; the number of seeds per fruit; the proportion of seed and surrounding semi-liquid pulp, to the solid flesh of the fruit, and the various relations of these points to each other in determining the value of a given variety. From each of the first twelve pickings a single fruit was selected,* representing as fairly as possible the variety from which it was taken. This fruit was then weighed, cut transversely, so that all the cells should be exposed to view, and a record made of their number. The seeds and pulp were then carefully removed from the cells and the former were counted. The remaining solid flesh of the tomato was weighed and the weight of pulp and seeds obtained by difference.

*At some pickings certain varieties bore no fruit, consequently less than twelve fruits were examined in a few cases.

Thus we have data for accurately determining both the relative and the absolute solidity of the different varieties. Solidity apparently depends upon a combination of several characteristics, prominent among which is the number of cells, or rather of cell partitions. The analyses reported by the chemist give added information upon this point, by showing the actual amounts of water and solids contained in the fruit. The relative seed production of the different varieties and classes is also shown. The results of these physical examinations are embodied in Table No. III.

In Table No. IV (which follows on pages 38 and 39), we have given in the double column A the varieties arranged in the order of *productiveness*; in column B they are arranged according to *size* of fruit; in column C according to *solidity*; and in column D according to relative *seed production*, the variety producing *least* seed being at the head of the column.

The names of the varieties, designated in this table only by numbers, can be obtained by reference to table No. 1.

The varieties bearing the largest fruit are found also to be among the heaviest bearers, and to have the largest proportion of solid flesh. But buyers generally object to the very large fruit of the "Mikado" class, and furthermore, we notice that most of the large pink varieties rot much quicker than do the red ones; this is notably the case with the Annie Dine, which is among the very first to become soft after picking.

The very large varieties being open to these serious objections, we are led to look further for the varieties deserving special mention, and we find among those which give, at the same time, a good percentage of solid flesh, (.75 or more) good productive qualities and a fair sized fruit (four ounces or more) the Ignotum, Paragon, Favorite, Belle, Fulton Market and New Jersey.

Next to the six kinds just mentioned we would place the

[Text continues on page 37.]

TABLE No. III.—Physical Characteristics of Tomatoes, by Varieties.

Garden No.	Name of Variety.	No. of fruits examined.	Average Weight in Grams.*			Per cent. flesh in fruit.	Average Average of		
			Single fruit.	Flesh.	Seed and pulp.		Cells per fruit.	Seeds per fruit.	Seeds per gram* of fruit.
800	Acme.....	11	134.0	90.0	44.0	.67	6.5	368	2.450
801	Advance.....	12	96.6	63.2	33.0	.66	4.7	356	2.165
802	Alpha, Ford's.....	12	127.0	91.3	35.5	.72	8.8	293	2.120
803	Annie Dine.....	9	241.7	199.3	42.3	.82	11.1	305	1.279
804	Atlantic Prize.....	12	133.8	103.6	30.2	.77	9.7	242	1.748
805	Bay State.....	10	194.5	140.6	53.9	.72	6.1	302	1.240
807	Belle.....	11	175.2	133.1	42.1	.76	7.5	248	1.305
808	Bermuda Ex. Ea.....	12	131.3	96.0	35.3	.73	8.2	204	1.500
809	Brandywine.....	12	184.5	132.0	52.6	.71	7.2	350	1.796
810	Bronze-leaved.....	7	237.0	189.0	48.0	.90	12.7	411	1.725
811	Bust's Beauty.....	8	179.4	131.8	47.7	.73	8.4	279	1.354
812	Cardinal.....	11	168.4	117.4	51.0	.69	7.4	361	2.021
813	Cincinnati Purp.....	7	187.4	149.0	38.5	.79	8.3	187	1.137
814	Climax.....	12	180.0	128.0	52.0	.71	7.0	376	2.164
815	Conqueror.....	12	110.9	81.4	29.5	.73	8.4	260	2.308
816	Earliest of All.....	12	126.7	90.7	33.0	.73	8.2	263	2.106
817	Early Jersey.....	12	182.0	133.7	48.2	.73	8.4	323	1.847
818	Essex Hybrid.....	11	149.0	106.0	43.0	.71	5.7	305	1.870
819	Advance (Ex. Ea.).....	11	220.0	160.0	60.0	.78	8.1	405	1.708
820	Faultless.....	11	112.5	80.0	31.5	.72	6.4	286	2.230

821	Favorite.....	11	232.0	174.0	58.0	.75	8.1	281	1.241
822	Gen. McClellan.....	10	251.0	204.5	46.5	.81	12.2	257	1.111
823	Golden Trophy.....	9	110.0	82.0	28.0	.74	9.8	192	2.045
824	Golden Queen.....	9	148.0	109.2	39.8	.74	5.4	286	2.000
826	Hundred Day.....	12	108.7	82.2	26.5	.76	10.3	265	2.410
827	Imp. Large Yellow.....	8	68.6	50.3	18.3	.73	3.0	109	2.924
828	Ivory Ball.....	9	51.3	38.0	13.2	.74	3.2	150	2.704
829	King Humbert.....	8	56.4	46.3	10.1	.82	2.0	101	1.825
830	Large Yellow.....	9	88.4	68.4	20.0	.77	10.0	178	2.221
831	Lorillard.....	10	153.5	112.8	40.7	.73	6.4	266	1.827
832	Matchless.....	8	208.0	152.0	56.0	.73	8.0	376	1.781
833	McCullom's.....	11	143.4	107.8	36.0	.75	5.5	204	1.430
834	Mikado.....	8	243.0	199.5	43.5	.82	10.9	227	1.131
835	Mikado.....	9	257.0	212.0	45.0	.82	11.7	310	1.162
836	Morning Star.....	10	206.0	162.0	44.0	.78	8.8	201	1.621
837	New Jersey.....	9	216.0	166.0	50.0	.76	8.8	274	1.186
838	New Queen.....	11	172.8	122.4	51.4	.71	8.1	382	2.157
839	New White Apple.....	9	50.7	37.2	13.5	.73	4.0	157	2.393
840	Optimus.....	9	162.0	111.0	51.0	.68	7.5	360	1.084
841	Paragon.....	9	192.7	139.0	53.7	.72	6.5	281	1.486
842	Paragon.....	9	174.0	131.7	42.7	.75	6.5	238	1.382
843	Peach.....	10	51.0	35.5	15.5	.70	3.5	138	2.674
844	Perfect Gem.....	9	165.7	124.0	41.5	.75	7.3	259	1.564
845	Perfection.....	9	183.5	134.0	49.5	.73	6.6	292	1.375
846	Potato-leaf.....	11	140.3	100.5	39.8	.71	6.0	291	2.116
847	Prize Belle.....	11	164.0	125.6	37.8	.76	6.4	272	1.686
848	Prize Belle.....	11	159.0	115.5	42.8	.73	7.1	191	1.257
849	Puritan.....	12	168.4	123.0	44.4	.73	7.2	274	1.564
850	Red Apple.....	11	167.0	120.0	47.0	.72	6.5	328	1.832
851	Scoville.....	11	189.0	141.0	48.0	.74	7.5	289	1.470

TABLE No. III.—CONCLUDED. *Physical Characteristics of Tomatoes, by Varieties.*

Garden No.	Name of Variety.	No. of fruits examined.	Average Weight in Grams.			Per cent. flesh in fruit.	Average Number of		
			Single fruit.	Flesh.	Seed and pulp.		Cells per fruit.	Seeds per fruit.	Seeds per gram of fruit.
833	Sunrise Yellow.....	7	160.0	121.0	39.0	.75	5.4	173	1.111
834	Shah.....	7	165.0	131.0	34.0	.79	8.9	174	1.137
835	Tree.....	9	127.0	96.0	31.0	.75	5.3	151	1.326
837	Trophy.....	11	240.0	199.0	41.0	.83	10.0	265	1.013
838	Turner Hybrid.....	10	248.5	205.0	43.5	.83	11.0	310	1.353
839	Turner Hybrid.....	9	274.0	227.0	47.0	.92	12.0	253	.962
860	Volunteer.....	12	216.6	157.5	59.0	.73	8.2	381	1.688
861	Haine's No. 64.....	12	164.6	118.6	46.0	.72	6.2	237	1.440
862	Fire King.....	12	112.1	82.8	29.3	.74	4.3	221	1.951
863	Ignotum.....	8	243.0	183.0	60.0	.75	8.0	276	1.055
864	Wonder of Italy.....	8	23.0	16.6	6.4	.72	2.1	83	3.700
865	Early Puritan.....	7	202.0	147.4	54.4	.73	8.0	305	2.093
866	Fulton Market.....	7	165.6	124.0	41.6	.75	7.1	267	1.894

* 28.35 grams make an ounce.

Queen, Puritan, Advance, Scoville, Early Jersey and Essex Hybrid, as possessing the desirable qualities of bearing large quantities of good sized, smooth fruit; the average weight per fruit in the above varieties ranges from four to five ounces.

There seems, therefore, to be no necessity for growing the over-large, ill-shapen varieties, of which the Mikado is a type, since equally heavy yields can be obtained from the medium sized, smooth, red sorts of the Paragon class.

Great solidity is obtained in the former, it is true, but an examination of Table No. IV, will show that this is accompanied by a large number of cells, as two varieties having a solidity of 90 and 92 per cent., respectively, have an average of 12.35 cells per fruit; the next seven varieties in the list having a solidity of from 81 to 83 per cent, give an average of 11.2 cells per fruit; seventeen varieties with from 75 to 79 per cent. solidity, average 8 cells per fruit, and thirty-four varieties varying in solidity from 70 to 74 per cent. have an average of 7 cells per fruit.

We therefore offer as a suggestion that possibly the future improvement of the tomato lies in the direction of seeking to multiply the number of cells in varieties of the most desirable type, if this can be done without increasing the irregularity of form.

In this connection we would say that by collecting and averaging the comparative data from ten selected varieties of this type, comparing the four smallest with the four largest fruits of the twelve specimens examined, it was found that the largest fruits gave an average of 8.4 cells with a solidity of 74.7 per cent. while the smallest fruits had an average of 6.5 cells, with a solidity of 72.4 per cent. Thus there seems to be some connection between the number of cells and the relative solidity of the fruits, even in the same variety. It has been shown, too, that there is at least a very strong possibility that the number of cells is

[Text continues on page 39.)

TABLE NO. IV.

Crop Product, Size, Solidity and Seeds of Tomatoes.

A		B		C		D	
Var.	Total yield in oz.	Var.	Av. Wt. single fruit in oz.	Var.	Per cent. of flesh.	Var.	No. seed Per G. of fruit.
No.		No.		No.		No.	
838	3107	858	7.64	859	.92	859	.962
849	3032	822	7.60	810	.90	857	1.013
819	2943	835	7.52	858	.83	863	1.055
851	2919	859	7.13	857	.83	853	1.111
858	2898	834	6.72	834	.82	822	1.111
857	2752	810	6.41	835	.82	834	1.131
807	2732	803	6.29	829	.82	813	1.137
817	2672	813	5.88	822	.81	854	1.137
818	2629	857	5.77	803	.82	835	1.162
836	2627	863	5.76	813	.79	837	1.186
803	2627	836	5.39	854	.79	805	1.240
805	2626	837	5.19	836	.78	821	1.241
814	2500	821	5.10	804	.77	848	1.257
835	2476	866	5.00	830	.77	803	1.279
859	2459	860	4.97	807	.76	807	1.305
841	2415	819	4.95	826	.76	855	1.326
861	2392	809	4.72	847	.76	858	1.353
816	2347	817	4.70	837	.76	811	1.354
802	2268	849	4.62	821	.75	845	1.375
837	2205	841	4.50	833	.75	842	1.382
840	2161	832	4.45	842	.75	833	1.430
821	2130	842	4.45	844	.75	861	1.440
813	2111	805	4.43	853	.75	851	1.470
847	2033	814	4.40	855	.75	841	1.486
815	2013	861	4.31	863	.75	808	1.500
842	1992	865	4.30	866	.75	849	1.564
865	1924	807	4.21	823	.74	844	1.564
863	1923	851	4.21	824	.74	806	1.588
834	1903	838	4.20	828	.74	836	1.621
806	1839	833	4.11	862	.74	847	1.686
843	1829	811	4.10	851	.74	860	1.688
822	1815	812	4.09	808	.73	819	1.708
831	1765	847	4.07	811	.73	810	1.725
850	1745	824	4.03	815	.73	804	1.748
832	1744	845	4.00	816	.73	832	1.781
848	1739	818	3.95	817	.73	809	1.796
845	1732	804	3.87	819	.73	840	1.804
801	1690	846	3.84	827	.73	829	1.825
824	1683	848	3.82	831	.73	831	1.827
833	1655	844	3.80	860	.73	850	1.832
808	1628	831	3.79	849	.73	817	1.847
844	1607	853	3.79	848	.73	818	1.870
820	1589	850	3.63	845	.73	866	1.894
866	1579	854	3.50	839	.73	862	1.951
812	1538	855	3.42	832	.73	824	2.000
829	1501	840	3.40	865	.73	812	2.021
811	1489	806	3.33	802	.72	823	2.045

TABLE NO. IV.—CONCLUDED.

A		B		C		D	
Var.	Total yield in oz.	Var.	Ay. Wt. single fruit in oz.	Var.	Per cent. of flesh.	Var.	No. seed Per G. of fruit.
No.		No.		No.		No.	
862	1475	856	3.33	805	.72	865	2,157
800	1437	800	3.16	820	.72	816	2,164
804	1433	802	3.08	861	.72	846	2,165
846	1410	816	2.83	850	.72	802	2,221
823	1352	820	2.82	841	.72	838	2,230
810	1218	815	2.75	864	.72	814	2,308
826	1158	823	2.71	806	.71	801	2,393
827	1099	862	2.64	809	.71	830	2,410
853	1098	826	2.64	814	.71	820	2,450
839	1097	852	2.25	818	.71	815	2,674
828	1071	801	2.18	846	.71	839	2,704
830	997	830	1.96	838	.71	826	2,924
855	694	827	1.65	843	.70	800	3,700
854	514	829	1.50	812	.69	843	.....
864	453	839	1.24	840	.68	828	2,093
852	74	828	1.22	800	.67	827	2,106
856	30	843	1.20	801	.66	864	2,116
...	..	864	.85	...	...	...	2,120

influenced by heredity.* This difference in solidity is not great, certainly, but is an indication to help in further study of this question of improvement of varieties.

There are few classes of plants in which there is a greater confusion of varieties than in the Tomato. Out of more than 60 varieties tried at this Station the present season, there are certainly not less than 15 which are indistinguishable one from another, so slight are the differences between them, if any really exist. Yet each is furnished with a name and were we to believe the laudatory statements of their introducers, each is far better than all the others. While part of this confusion is due, undoubtedly, to the re-naming of old varieties, another part is due to the tendency to variation, and to a lack of fixity of type in the different sorts. Another cause we believe to be the tendency to "reversion to ancestral types," spoken of by Dr. Sturtevant in his article. (See p. 23.) Many new varieties appar-

*Goff. Reports N. Y. Agr'l Expt. Station, 1884, p. 226, 1885, p. 185.

ently alike, are known to be the offspring of different parentages, or nothing may be known of their origin, and since they come from different sources they are given different names, when comparison with each other shows them to be the same, or at least identical for all practical purposes.

Comparing the varieties with reference to their seed producing qualities, we find, in general, that the largest tomatoes have the smallest number of seeds to a given weight of fruit, and that many of the varieties which were considered worthy of special mention for other reasons, are found among those producing the smallest number of seeds per gram of fruit, while on the other hand the smallest fruits have the largest proportional number of seeds. For example, the Wonder of Italy, Ivory Ball, and Peach stand near the bottom of the column, while the Turner Hybrid, Trophy, Gen. McClellan, and others of that class are at the top.

Next, we see that the varieties generally classed as early, viz: Acme, Hundred Day, Conquerer, &c., are among the largest seed producers, while such varieties as Ignatum, New Jersey, and Favorite stand near the other extreme. (See Table No. IV.)

Before planting the seed from which our tomatoes were grown, a vitality test was made of it and at the same time given numbers of the seed from most of the varieties, were weighed. From these weights it was found that the average number of tomato seeds per pound is 151,350.

Comparing the number seed per pound, (which obviously gives us, also, the relative size of the seed for the different varieties,) with the relative seed production, we find that those varieties giving the *smallest* numbers of seed per gram of fruit, are among those having the largest seed, as ascertained by weighing the dry seed, while those producing the *largest* numbers of seed per gram of fruit, are among those, the size of whose seed is below the average.

EARLINESS.—The three varieties producing the largest amount of fruit previous to August 1st, as shown by Table No. I, are Alpha, Conqueror, and Earliest of All.

The five varieties producing the largest quantities of

fruit previous to and including July 18th, are as follows:

Advance	52 ounces.	Alpha	45 ounces.
Bermuda Ex.Ea.	35 “	Conqueror	108 “
Earliest of All.	79		

It will be seen that the three kinds first named are included in this latter list, so we may consider that the figures given in Table No. I, accurately represent the comparative earliness of the varieties.

NOTES ON VARIETIES.

Most of the varieties grown by us this season, have been fully described in the Reports of the New York Agricul Experiment Station at Geneva, and in the Bulletins of the Michigan Agricultural College, so it is unnecessary to repeat detailed descriptions of all the varieties. A few general notes upon some of them are given however.

Annie Dine. A new variety with some of the characteristics of the Mikado, having the pinkish color and very large size of that variety. The foliage is of the ordinary type, not potato leaved. It is one of the first varieties to become soft after picking.

Cincinnati Purple. Another large pink-fruited variety, but rarely ripening up to the stem; generally the upper third of the fruit turns to a yellowish red color, without becoming fully ripe. This variety was of no value with us.

Golden Trophy. Small; bright yellow color: much wrinkled; of no special value.

Golden Queen. A very good yellow Tomato; color light, with a slight tendency to be reddish at the blossom end.

Sunrise Yellow. Same as Golden Queen; the best of the yellow tomatoes.

Improved Large Yellow. Why this should be called "Large," we do not know, as it was among the smallest; but it is very regular in form, nearly globular, and of a bright orange color; keeps sound a long time after picking.

Ivory Ball. This is the New White Apple under another name; a small very light colored tomato; good for preserving.

King Humbert. An old sort, of no special value here; often rots before ripening.

Large Yellow. Differs very little from Golden Trophy, except in averaging smaller in size of fruits.

Morning Star. This variety (?) was so badly mixed, or so very variable, that we were in doubt for some time, as to what was its intended type. Probably it was intended to be a variety similar to the Mikado, but it should not have been offered for sale until fixed in character.

Station. A reference to the Table of yields will show the value of this variety here, and also that of the *Tree (Maule)*. Neither produced fruit in any quantity or of any value the present season.

Tree. (Everitt.) This proves to be not the Tree Tomato at all, but simply the Dwarf Champion, or a variety very closely allied to it in general appearance.

Fire King. Shape, somewhat inclined to oval; size, small to medium; average weight of fruit 2.64 ounces; color very deep red. Is too small to be of value among so many better kinds.

Ignotum. This variety well deserves special mention, and will undoubtedly prove a valuable addition to the list of really desirable varieties, when introduced. We know of nothing better in our list. It was sent out from the Michigan Agricultural College, and in size, color and shape, it is among the very best; in productiveness, although not standing very near the top of the list, it is within the limit of variation for some of the most productive varieties: moreover, it must be borne in mind that it was planted three weeks later than most of the others.

Wonder of Italy. This is probably the old Pear-shaped red.

The Shah. A shy bearer, not as good in shape as Golden Queen. The only yellow variety having a potato leaf. Not specially valuable.

CONCLUSIONS FROM THE VARIETY TEST OF TOMATOES.

1. The larger the fruit the greater the number of cells; this holds true not only with the fruits of different varieties, but with the fruits of a given variety, compared with each other.
 2. The larger the number of cells the greater the solidity of the fruit as measured by the proportion of solid flesh to seed and pulp.
 3. The larger the fruit the smaller the proportional number of seeds.
 4. In general terms the varieties producing the larger fruits are among the heaviest bearers.
 5. The most promising varieties for general culture are Ignotum, Paragon, Favorite, Belle, Fulton Market, and New Jersey.
 6. The earliest varieties this season were Conqueror, Earliest of All, and Alpha. To these may be added Bermuda and Advance.
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II.—FERTILIZER TEST WITH TOMATOES.

The land for this experiment was much the same in character as that for the variety test, possibly a little more moist.

It had a crop of rye turned under about May 1st, in addition to a crop of cow peas that was plowed in, in the fall of 1888.

The section taken was 63 ft. wide by 216 ft. long, and was divided into 12 plots, 63 ft. x 17.3 ft., each containing one-fortieth of an acre.

Fourteen varieties of tomato were selected and set in as many rows, extending the whole length of the series of plots.

Thus, the plan was that each variety should be equally represented upon each plot. The plants, four of each variety to each plot, (total 56 plants per plot) were set four and one-half feet apart each way.

They were from the same planting of seed as the plants used in the variety test, and were set in the field June 10 and 11. The weather being favorable, in a few days all were well established and growing finely, but the disease referred to later, broke what would otherwise have been practically a perfect stand, and caused irregularities in the records. In a few cases, when the supply of plants of a given variety fell short, we were obliged to substitute another in its place. These instances are noted in the proper place.

The kind and amounts of fertilizers are given in the following table. The analyses of the ingredients will be found elsewhere.

Plot 1.	Nitrate of soda,	4 lbs., equal to 160 lbs. per acre.		
" 2.	Dried blood,	6 do.	do. 240 do.	do.
" 3.	Dissolved bone black,	8 do.	do. 320 do.	do.
" 4.	Nothing.			
" 5.	Muriate of potash,	4 lbs., equal to 160 lbs. per acre.		
" 6.	{ Nitrate of soda,	4 do.	do. 160 do.	do.
	{ Dissolved bone black,	8 do.	do. 320 do.	do.
" 7.	{ Nitrate of soda,	4 do.	do. 160 do.	do.
	{ Dissolved bone black,	16 do.	do. 640 do.	do.
" 8.	{ Nitrate of soda,	4 do.	do. 160 do.	do.
	{ Muriate of potash,	4 do.	do. 160 do.	do.
" 9.	Nothing.			
" 10.	{ Nitrate of soda,	4 do.	do. 160 do.	do.
	{ Muriate of potash,	8 do.	do. 320 do.	do.
" 11.	{ Dissolved bone black,	8 do.	do. 320 do.	do.
	{ Muriate of potash,	4 do.	do. 160 do.	do.
	{ Nitrate of soda,	4 do.	do. 160 do.	do.
" 12.	{ Muriate of potash,	4 do.	do. 160 do.	do.
	{ Dissolved bone black,	8 do.	do. 320 do.	do.

The fertilizers for each plot were well mixed, sown broadcast, and harrowed in the day before the plants were set.

From some cause not fully explained, presumably the attack of some fungous disease, several of the plants used in this experiment died before fruiting, and after having recovered from the shock of transplanting; we lost few, if any, from the latter cause. The stand was thus broken and we were prevented from getting a complete record of all varieties on all the plots.

In a few instances we were obliged to substitute plants of other kinds for the varieties originally intended.

Mainly from causes beyond our control, our records are

incomplete; we have, therefore, tried to present the returns from this experiment by three methods of averaging results, so that our few conclusions may have as strong evidence as possible in their support.

In the first columns of Table V, we have used the whole fourteen varieties wherever half the normal number of plants of each variety was present, calculating the deficiencies to a full stand. In later columns, we have used five varieties which had very nearly full stands, and again calculated the deficiencies, thus getting a record which is more nearly correct than in the first case. In the last column we give the average of the only two varieties in which the stand was perfect.

TABLE No. V.
Comparative Yield of Fertilizer Plots.

	No. of Var's.	Total yield in oz.	Av. yld. per var in oz.	Total yld. 5 vars in oz.	Av. yld. per var in oz.	Av. yld. of 2 var in oz.
Plot No. I.....	14	7,622	538	2,970	594	874
" " II.....	14	3,841	264	1,735	320	325
" " III.....	14	3,733	267	1,956	311	383
" " IV.....	13	2,938	226	1,289	258	305
" " V.....	12	3,862	322	1,695	339	415
" " VI.....	13	3,875	298	1,623	324	310
" " VII.....	13	4,104	316	1,830	366	279
" " VIII.....	14	4,068	291	1,705	341	306
" " IX.....	14	3,579	256	1,538	308	257
" " X.....	13	4,447	342	1,492	298	291
" " XI.....	12	3,368	280	1,644	329	456
" " XII.....	12	252	438	1,976	395	458

In Table VII, the average yield per variety is given, for each plot, obtained by the three different methods of computation described above, and arranged according to the yield, the largest at the top. For this Table see page 48.

Certain well-marked results are to be noticed from this table. We find that Plots I and XII stand at the top as giving the heaviest yields. It must be noted, however, that

[Text continues on page 48.]

TABLE No. VI.
Total Yield in Ounces and Number of Fruits of the Varieties Used in the Fertilizer Test.

Number of Plot.	Acme.		Beauty.		Cardinal.		Early Jersey.		Essex Hybrid.		Hundred Day.		Queen.		Optimus.		Paragon.		Perfection.		Potato-leaf.		Prize Belle.		Trophy.		Turner Hybrid.	
	No. 800.	No. 806.	No. 812.	No. 817.	No. 818.	No. 826.	No. 838.	No. 840.	No. 841.	No. 845.	No. 846.	No. 847.	No. 857.	No. 858.														
I	1002	912	836	522	453	328	510	325	466	383	366	443	3189	504														
	206	236	179	127	116	181	130	104	118	89	78	130	28	69														
II	367	383	266	137	300	195	3235	152	186	225	176	241	259	501														
	82	89	58	31	94	67	56	44	41	53	46	65	44	62														
III	347	348	419	275	256	229	179	296	415	192	263	277	174	200														
	88	103	104	63	72	98	45	88	100	50	17	72	26	32														
IV	307	315	296	306	239	119	285	62	138	384	111	3128	3146	345														
	87	92	80	92	67	48	69	19	39	23	35	51	25	72														
V	471	470	361	394	371	194	322	402	2183	195	3125	212	274	224														
	117	102	97	96	107	90	90	91	57	40	34	67	37	34														

VI	{ Oz. { No.	568 113	286 79	334 97	x224 38	xx227 48	xx280 67	xx249 82	295 83	388 86	232 65	3138 44	3182 56	345 67	2135 25
VII	{ Oz. { No.	621 150	445 127	113 38	170 44	225 81	3189 100	3244 88	102 40	215 59	191 53	269 20	288 48	445 62	612 95
VIII.....	{ Oz. { No.	471 103	199 47	414 91	270 31	335 113	298 103	246 52	119 38	132 35	142 49	133 61	3254 55	472 94	488 65
IX.....	{ Oz. { No.	x288 70	277 63	238 67	260 67	256 69	98 56	3164 45	216 73	258 73	196 54	152 43	364 102	397 73	368 52
X.....	{ Oz. { No.	x569 113	342 93	2341 60	376 92	312 100	402 181	xx424 99	276 79	3227 61	251 72	153 20	x241 69	294 55	3312 64
XI.....	{ Oz. { No.	x549 112	463 100	449 120	345 89	3421 89	217 116	296 76	297 26	272 28	3206 55	268 70	3266 72	445 75	143 17
XII.....	{ Oz. { No.	650 134	334 109	533 129	398 144	584 141	362 143	584 133	1103 32	440 109	297 75	300 62	xx377 115	2138 28	3257 41

x No. 866. xx Mixed.

NOTE.—Four plants of each variety per plot constituted a full stand; where less than this number of plants fruited, the fact is denoted by small figures (1, 2, 3,) attached to the weights given.

these plots stood respectively at either end of the series, and moreover, there are strong reasons for thinking that the land occupied by Plot I, was better adapted to producing crops than that occupied by the other plots.

Dividing the remainder of this table into three sections, *a, b, c*, giving thus in each section the plots having the highest (*a*), lowest (*c*) and medium (*b*) yields, we find that with one exception the plots having no fertilizer fall in the section of lowest yield.

TABLE No. VII.

Accrages arranged according to production.

Weights in Ounces.

Average of 14 Varieties.		Average of 5 Varieties.		Average of 2 Varieties.	
Plot I.	Oz	Plot I.	Oz.	Plot I.	Oz.
Nit. of Soda ..	538	Nit. of Soda...	594	Nit. of Soda...	874
Plot XII.		Plot XII.		Plot XII.	
Nit. of Soda. }		Nit. of Soda. }		Nit. of Soda. }	
Ph. Ac., Pot. }	438	Ph. Ac., Pot. }	395	Ph. Ac., Pot. }	458
Plot X.		Plot VII.		Plot XI.	
Nit., Potash ..	342	Nit., Ph. Ac...	366	Ph. Ac. Potash	456
Plot V.		Plot VIII.		Plot V.	
Potash	322	Nit. of Soda. }	371	Potash.....	415
Plot VII.		Potash..... }		Plot III.	
Nit. of Soda. }		Plot V.		Ph. Ac.....	383
Ph. Acid.... }	316	Potash.....	339	Plot II.	
Plot VI.		Plot XI.		Dried Blood ..	325
Nit. of Soda. }		Ph. Ac..... }		Plot VI.	
Ph. Acid.... }	298	Potash..... }	329	Nit. of Soda. }	
Plot VIII.		Plot VI.		Ph. Acid.... }	310
Nit. of Soda. }		Nit. of Soda. }		Plot VIII.	
Potash..... }	291	Ph. Ac... }	324	Nit. of Soda. }	
Plot XI.		Plot II.		Potash..... }	306
Potash..... }		Dried Blood ..	320	Plot IV.	
Ph. Ac..... }	280	Plot III.		Nothing	305
Plot III.		Ph. Acid.....	311	Plot X.	
Ph. Ac.....	267	Plot IX.		Nit. of Soda. }	
Plot II.		Nothing	308	Potash..... }	291
Dried Blood ..	264	Plot X.		Plot VII.	
Plot IX.		Nit. of Soda. }		Nit. of Soda. }	
Nothing	256	Potash..... }	298	Ph. Acid.... }	279
Plot IV.		Plot IV.		Plot IV.	
Nothing	227	Nothing	258	Nothing	257

Next we see that plots upon which nitrogen was used fall in *a* four times, in *b* five times, and in *c* three times. Potash is found six times in *a*, four times in *b*, and twice in *c*; while phosphoric acid is found five times in *a*, seven times in *b*, and not at all in *c*.

Thus there are indications from this experiment, that the regulating ingredients in a fertilizer for tomatoes on this soil are Nitrogen and Potash, while Phosphoric Acid has less effect.

We should not feel justified in further conclusions, but have given the figures in detail for comparison and future reference. (See Table No. VI, pages 46 and 47.)

In this connection, we mention a very unsuccessful preliminary trial of growing tomatoes in boxes of sand, the original intention being to thus have a miniature counterpart of the field plots and a check upon them.

Twelve plain wooden boxes were made, of the same size, eleven inch cubes, and in each put 60 lbs. of pure sand, which had been washed and thoroughly heated to destroy all organic matter. Fertilizers, in kind and quantity as stated below, were mixed with the sand in the several boxes.

Box 1 Nitrate of Soda... 2½ oz.	Box 8 { Nitrate of Soda.. 2½ oz.
" 2 Dried Blood..... 3¼ "	" { Muriate of Pot.. 2½ "
" 3 Dissolved Bone, Black..... 5 "	" 9 { Muriate of Pot...2½ "
" 4 Nothing.....	" { Dissolved Bone Black.....5 "
" 5 Muriate of Potash 2½ "	" { Dried Blood....3¼ "
" 6 { Nitrate of Soda.. 2½ "	" 10 { Nitrate of Soda..2½ "
" { Dissolved Bone Black..... 5 "	" { Muriate of Pot...5 "
" 7 { Nitrate of Soda.. 2½ "	" 11 { Dissolved Bone Black..... 5 "
" { Dissolved Bone Black.....10 "	" { Muriate of Pot...2½ "
	" 12 { Nitrate of Soda..2½ "
	" { Muriate of Pot...2½ "
	" { Dissolved Bone Black.....5 "

On June 15th a single plant of Livingston's Beauty was set in each box. The boxes were placed on boards to keep

them from direct contact with the earth, and set in an ordinarily exposed position in the garden. They were watered with distilled water, whenever the rain failed to keep the sand sufficiently moist.

On September 5th it was discovered that the roots from the most vigorous plants (see *resume* on following pages), had pushed their way through the joints of the boxes and extended some distance between the bottoms of the boxes and the boards on which the latter were placed.

This caused a failure of the experiment from a scientific standpoint, but the results are worthy of record in a general way. Therefore the following notes are presented, as possibly giving some indications of the food requirements of the tomato plant.

The final notes were taken just before the plants were killed by frost, when the growing season ended.

Box 1. This plant has formed a stem about three feet long, with but one branch. Three fruits have set, but one of which has ripened, and it is a little less than the average size of the variety.

Box 2. This plant dwindled away and died without making any new growth.

Box 3. Five fruits have formed, none ripened, and the growth of vine is about as much greater than that of the plant in Box 1, as is the fruit production, the fruits being of about the same average size in both cases.

Box 4. The vine is about one foot long, with one small branch; produced no fruit.

Box 5. Made a little more growth than No. 4, and like it, produced no fruit.

Box 6. Made the best growth of any of the plants, producing also the first ripe fruit, and the largest number of fruits, having ripened fifteen specimens weighing 69 ounces, previous to September 22nd. No other plant produced half as many. In amount of vine it approached the normal amount found with a light crop of fruit in field culture.

Box 7. In amount of vine this plant stood below No. 6 and about the same as Nos. 8 and 12.

Box 8. Practically the same as No. 7.

Box 9. This plant lost all of its original stem, but started again at the surface of the sand and formed a stem about six inches long.

Box 10. Made a single stem about two feet long and produced two small fruits, neither of which ripened.

Box 11. Made a little less growth than No. 10, but formed no fruit.

Box 12. Made about the same amount of growth as No. 7 and No. 8.

It will be seen that the most vigorous growth and best fruit production were where only nitrate of soda was used, with the minimum amount of phosphoric acid in the form of dissolved bone black.

We hope to repeat this experiment under more accurate conditions.

III.—POTATO EXPERIMENTS.

In Bulletin No. 2 we reported the results of a trial of different quantities of seed potato, based on the yield of small plots. This season we proposed to further investigate this subject by using a whole field instead of a small plot.

With this end in view, an acre was planted with two varieties of early potatoes, and another acre with two varieties of late potatoes.

The four sizes of seed correspond to those used last season, and were designated respectively A, B, C, and D.

A. represents a whole potato about ten ounces in weight.

B. a whole potato about the size of a hen's egg.

C. the usual cutting, a piece equal to about one quarter of a fair sized tuber; the piece containing from two to four eyes.

D. is a piece containing one eye, cut from a fair sized tuber.

One whole tuber or one piece, was placed in each hill.

The hills were two feet apart and the rows two and a half feet apart.

The seed for each row was weighed, and as there was the same number of hills in each row, the average weight of seed per hill can be easily computed.

The fertilizer was, first, a light dressing of lime-kiln ashes broadcast, then 500 pounds of dried ground fish and 150 pounds of muriate of potash, broadcast and harrowed in. In the rows was put 350 pounds of dried ground fish. Thus 1000 pounds of fertilizer was used (exclusive of the ashes, which had very little potash), containing 67 pounds of nitrogen, 89 pounds of phosphoric acid and 78 pounds of potash to the acre.

The early potatoes were planted on March 18th and 29th, rain coming after we began planting on the 18th, and preventing further work until the latter date. The late ones were planted June 25th. The early varieties were Beauty of Hebron and New Queen, from George W. P. Jerrard, Caribou, Me., and the late varieties, Dandy, from the same source, and Empire State, from C. R. Hartshorne, Montgomery county, Md.

The early varieties were dug August 12th to 14th, and the late ones October 3d to 5th. All the vines were dead in each case.

In reporting the results, the record of the whole of the acre of late potatoes is used, but of only a portion of that of the early potatoes. This is because the latter were badly damaged by a very heavy rain storm immediately after planting (*), and another a little later, followed by an unusually wet season. The portion selected was at one side of the field, was first planted and less damaged by the rains. This fact also accounts for the much smaller proportion of missing hills in the early varieties than in the late ones.

In Table No. VIII., the actual yield of potatoes is given in pounds. There were 13 rows of each form of planting of the Dandy and Empire State (together), or 52 rows in all on the acre, with 168 hills in each row. The rows of Beauty of Hebron and New Queen contained each 121 hills, or one seventy-second of an acre. The table gives the product of but two rows of each form of planting of the early kind, or sixteen rows in all, being two-ninths of the acre.

(*) See Meteorological Record.

TABLE No. VIII.
Actual Yield of Potatoes in Pounds.

SECTION A.

Form of Planting.		Dandy. 7 rows.	Empire State. 6 rows.	Beauty of Hebron. 2 rows.	New Queen. 2 rows.
One large whole potato	Missing Hills	132	147	0	3
	Merchantable Potatoes, lbs. . . .	467	242	309	356
	Unmerchantable . .	490	336	221	295
	Total in lbs	957	578	530	651

SECTION B.

One whole potato, egg size.	Missing Hills	263	235	3	13
	Merchantable potatoes, lbs.	370	213	280	324
	Unmerchantable . . .	222	232	145	161
	Total in lbs.	592	445	425	485

SECTION C.

One piece as per usual cut- ting.	Missing Hills	244	314	22	52
	Merchantable potatoes lbs.	286	218	219	151
	Unmerchantable . . .	154	145	81	66
	Total in lbs.	440	363½	300	217

SECTION D.

One piece, single eye.	Missing Hills	423	525	72	133
	Merchantable potatoes, lbs.	150	101	103	116
	Unmerchantable . . .	65	58	40	48
	Total in lbs.	215	159	143	164

On the basis of the record in Table No. VIII, a computation has been made of the crop produced in bushels per acre. This form is more convenient for general use and is given in Table No. IX.

TABLE No. IX.—General Average of Results Computed in Bushels per Acre.

	A. Yield.		Per cent. of Missing Hills.	B. Yield.		Per cent. of Missing Hills.	C. Yield.		Per cent. of Missing Hills.	D. Yield.	
	Merchanta- ble, Bushels.	Total, Bushels.		Merchanta- ble, Bushels.	Total, Bushels.		Merchanta- ble, Bushels.	Total, Bushels.		Merchanta- ble, Bushels.	Total, Bushels.
Beauty of Hebron.	185.4	318.0	00.00	168.0	255.0	1.24	131.4	180.0	9.09	61.9	85.9
New Queen.	213.6	390.6	1.24	134.4	231.0	5.37	90.6	130.2	21.50	69.6	98.4
Pandy.	57.8	118.4	11.22	46.0	73.2	22.36	35.6	54.4	20.75	18.8	26.8
Empire State.	34.8	83.6	14.57	30.8	64.0	23.30	31.6	52.4	31.14	14.4	22.8
Av. of Early Vars.	199.5	354.3	00.62	151.2	121.5	3.30	111.0	155.1	15.59	65.7	92.2
Seed Planted.	85.8	.....	.....	27.4	.....	.....	13.5	.....	.....	5.1	.....
Prod. over seed.	113.7	.....	.....	123.8	.....	.....	97.5	.....	.....	60.6	.....
Av. of late Vars.	46.2	101.0	12.89	38.4	68.6	22.83	33.6	53.4	25.94	16.6	24.8
Seed Planted.	74.5	.....	.....	21.3	.....	.....	9.2	.....	.....	4.6	.....
Prod. over seed.	* 28.2	.....	.....	17.1	.....	.....	24.4	.....	.....	12.0	.....

* Less than amount planted.

A study of these tables emphasizes the law laid down in Bulletin No. 2, that the greater the quantity of seed potato planted, the greater the total yield. The yield of merchantable tubers is, also, correspondingly greater. But it is shown that the very large seed is not profitable, neither is a very small quantity, the medium amounts giving the largest returns above quantity planted, as in B., and C.

The number of unproductive and missing hills increases as the quantity of seed diminishes. This is one of the striking facts of the tables, and shows that, in a wet season particularly, the crop from whole tubers is much surer.

In digging the crop, each hill was thrown out separately, and all hills producing tubers were counted. The difference between this number and the total number of hills per row as planted, gives the actual number of missing or totally non-productive hills. In July, after the potatoes had made a good growth, the hills were counted where there were no vines. The final number of missing hills was greater than the July count. This shows that a number of hills which started vines sufficiently to be included in July, were finally non-productive. And this number was found to increase invariably with the decrease in seed planted; that is, the less the seed the more uncertain the crop.

Attention is called to the marked difference in yield between the Dandy, a new variety the seed of which was obtained in Maine, and the Empire State, from seed grown in one of the best potato growing sections of Maryland.

	A.	B.	C.	D.	
	Merch.	Merch.	Merch.	Merch.	
Maine Dandy ...	467 lbs.	370	286	150	7 rows.
Md. Empire State.	282 lbs.	248	254	118	Calc. to 7 rows.

The conclusions are:

1. That the most profitable seed is the medium, represented here by "B," an uncut potato the size of an egg in each hill.

2. That the smaller the seed used and the more it is cut, the less the probability of getting a full stand, and when the seed is cut to a single eye this increase of missing hills very materially reduces the crop.

IV.—COMPARISON OF SEED POTATOES FROM VERMONT AND MARYLAND.

Hoping to learn something of the relative merits of southern and northern grown seed potatoes, we exchanged seed with the Vermont Experiment Station, and duplicate plantings were made, both at this Station and in Vermont, of several varieties which each Station had grown in 1888. Thus we had duplicate experiments at the Maryland and Vermont Stations with seed grown in each place.

All conditions were made as nearly alike as possible. The land was of similar character; the distance between the rows was 3 feet 6 inches in Vermont, and 3 feet 7 inches in Maryland, and the distance between the hills was 18 inches, in both places.

The potatoes were cut into pieces having two eyes each, and the weight of the pieces in the two lots was made the same.

The potatoes were planted at this Station on May 4th, and dug September 4th. In Vermont they were planted June 12th, and dug October 12th.

At the Vermont Station twelve hills were planted with each lot of seed. At the Maryland Station ten hills. In our report, the results are all calculated to a basis of twelve hills. (See Table No. X, on next pages.)

A few varieties were grown in Vermont which were not grown here, but we give the results from those varieties in a separate table. (See Table No. XI, on page 59.)

The season was exceedingly unfavorable in both places. Here, the excessive moisture evidently prevented the growth of the tubers, although the vines looked well throughout the season. No differences were noticed in the vines, which could be attributed to influence of seed.

In Vermont, the vines blighted about August 5th, and thus the yield was reduced there also.

It will readily be seen that the difference is in favor of the Vermont grown seed, this giving the larger total yield in each of the tables.

TABLE X.—*Comparison of Potatoes from Northern and Southern Seed.*

No.	Twelve Hills. Name.	Yield from Maryland Seed, at Vermont Exp't Station.			Yield from Vermont Seed, at Vt. Exp't Station.		
		Merch.	Unmer.	Total.	Merch.	Unmer.	Total.
		lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
28	Stray Beauty.....	6 1	1 5	7 6	7 8	1 8	8 6
31	Thorburn.....	4 1	1 13	5 14	4 7	12	5 3
38	Dakota Red.....	7 12	4	8 0	12 5	8	12 13
39	Empire State.....	6 14	12	7 10	3 15	12	4 11
82	Home Comfort.....	7 12	12	8 8	13 12	7	14 3
55	Rural Blush.....	11 8	11	12 3	7 4	5	7 9
71	Delaware.....	7 1	12	7 13	11 10	1 1	12 11
75	Farina.....	3 12	7	4 3	6 1	13	6 14
		54 13	6 12	61 9	66 14	6 2	73 0

TABLE X.—CONTINUED. *Comparison of Potatoes from Northern and Southern Seed*

No.	Twelve Hills. Name.	Yield from Maryland Seed, at Md. Exp't Station.			Yield from Vermont Seed, at Maryland Exp't Station.		
		Merch.	Unmer.	Total.	Merch.	Unmer.	Total.
		lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
28	Stray Beauty.....	3 2	2 2	5 4	5 5	3 10	8 15
31	Thorburn.....	4 8	4 4	8 12	2 7	4 9	7 0
38	Dakota Red.....	3 1	4 0	7 1	7 3	4 0	11 3
39	Empire State.....	6 8	4 14	11 6	7 12	3 4	11 0
82	Home Comfort.....	1 5	1 2	2 7	1 8	1 5	2 13
55	Rural Blush.....	5 4	3 1	8 5	6 9	2 3	8 12
71	Delaware.....	3 8	2 11	6 3	6 4	2 3	8 7
75	Farina.....	1 13	2 4	4 1	2 9	2 4	4 13
		29 1	24 6	53 7	39 9	23 6	62 15

TABLE XI.—*Additional Varieties Tried at the Vermont Experiment Station.*

No.	Name.	Yield from Maryland Seed.			Yield from Vermont Seed.		
		Merch.	Unmer.	Total.	Merch.	Unmer.	Total.
		lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
3	Beauty of Hebr.....	5 0	1 1	6 1	3 11	15	4 10
4	Chas. Downing.....	3 12	2 6	6 2	3 4	2 5	5 9
10	Early Mayflower.....	5 7	1 10	7 1	7 8	14	8 6
17	Ex. Ea. Vermont.....	5 1	1 14	6 15	7 8	10	8 2
13	Early Ohio.....	4 3	14	5 1	9 0	10	9 10
82	Home Comfort.....						
23	Nott's Victor.....	1 0	1 7	2 7	2 13	1 4	4 1
45	Monroe Co.....	5 3	2	5 15	7 3	10	7 13
		29 10	10 0	39 10	40 15	7 4	48 3

V.—GENERAL NOTES ON VEGETABLES.

The character of this season was such that we were practically obliged to abandon several kinds of vegetables after planting, and discontinued the records. But some notes were made and may be worth recording. In general these notes are simply an indication of the capability of the varieties to withstand unfavorable meteorological conditions.

(Full lists of the varieties planted will be found in Bulletin No. 5, published in June, 1889.)

Beans.—The bush beans which were most vigorous and appeared to be making a normal, healthy growth, were Canadian Wonder, Navy, Refugee Extra Early, Golden Refugee, White Marrow, White Wonder. These were classed as "best" in our notes. Among the Wax beans, which were as a class not as good as the other bush beans, a few were recorded as "good," viz: Dwarf White, Golden Eyed, Ivory and New Kidney.

In the pole beans, the varieties deserving special mention are, California Wax, Kentucky Wonder, Powell's Prolific, R. I. Creaseback.

Carrots—About July 15th, most of the varieties which previously had been growing very finely, were attacked by "blight" which destroyed nearly all of the leaves and therefore prevented further growth. Those least affected were, Deep Ponder, Long Orange, Imp. Long Orange.

Cabbage—Early. The varieties of early cabbage that best resisted the elements and succeeded in forming heads on half or more of the plants set out were, Succession, Reed-land Drumhead, Louisville Drumhead, Henderson's Early Summer.

Lettuce.—A very satisfactory growth was made, but it is manifestly impossible to give any tabular statement that will accurately or satisfactorily represent the differences in varieties.

On June 7th, fifty-three days after the plants were set in the garden, most of the varieties were at their best stage of

growth. Three average heads of each variety were weighed and the average weight per head is here given as affording some information concerning the "productiveness" of the varieties.

(The varieties are arranged according to their size.)

		Per head.
1. Marble Head Mammoth.....	Seed from Greg.	9 1- 8 oz.
2. Sugar Loaf.....	" "	8 3- 8 "
3. Chartiers.....	" Vaughn.	8 1- 4 "
4. Large White Summer.....	" Thor.	7 1-12 "
5. Salamander.....	" "	6 2- 3 "
6. Everlasting.....	" Cleve.	6 1- 2 "
7. Golden Stone Head.....	" "	6 7-16 "
8. Early Curled Simpson.....	" Thor.	5 15-16 "
9. Silver Ball.....	" Buist.	5 1- 8 "
10. Landreth's Forcing.....	" Land.	5 3- 4 "
11. Large Yellow Butter.....	" Thor.	5 9-16 "
12. American Oak Leaved.....	" "	5 9-16 "
13. New York.....	" Ely.	5 1- 2 "
14. Philadelphia Market.....	" Buist.	5 5-12 "
15. Defiance.....	" Greg.	5 1- 6 "
16. Tomhannock.....	" Cleve.	5 1-12 "
17. California Cream Butter....	" J. & S.	5 "
18. Lacinated Beauregard.....	" Thor.	4 1- 8 "
19. Peer of All.....	" Salzs.	4 1- 8 "
20. White Russian Summer....	" J. & S.	4 1- 8 "
21. Tennis Ball, <i>Ward's Imp.</i> ...	" Greg.	4 5- 6 "
22. Shotwell Brown Head.....	" Thor.	4 5- 8 "
23. M'k't Gard's Private Stock.	" "	4 1- 2 "
24. Bloomsdale E'y Summer....	" Land.	4 1- 4 "
25. Perfection White Forcing..	" Buist.	4 1-12 "
26. Tennis Ball, <i>Large Strain</i> ..	" Thor.	4 "
27. California All-Heart.....	" J. & S.	3 3- 4 "
28. Rudolph's Liebling.....	" Vaughn.	3 3- 4 "
29. Tennis Ball or Boston.....	" Thor.	3 2- 3 "
30. Golden Ball.....	" N. B. & Co.	3 7-12 "
31. Midsummer.....	" Burp.	3 1- 2 "
32. Bloomsdale Reliable.....	" Land.	3 3- 8 "
33. Buttercup.....	" Greg.	2 5-16 "

Names which may be considered as synonyms are as follows :

Bloomsdale Early Summer, Bloomsdale Reliable, Market Gardener's Private Stock (*Thor.*); Everlasting, Large Yellow Butter, New York, White Russian Summer; Defiance, Philadelphia Market, Salamander, Silver Ball; Buttercup, Rudolph's Liebling, Golden Ball; Landreth's Forcing, Perfection White Forcing, Tennis Ball.

Peas.—This crop was practically a failure with us, but the following varieties produced edible pods on May 28th, seventy days after planting.

Alaska, (*Cleve.*;) Beck's Gem, (*Land.*;) Bergen Fleetwing, (*Cowan*;) Premier Extra Early, (*Buist*;) Early Frame, (*Land.*;) Early Morning Star, (*Buist*;) First and Best, (*Thor.*;) Carter's Lightning, (*Currie*;) Lightning, (*Our own Stock*;) (*Currie*;) Rural New Yorker, Small French.

This emphasizes the fact, already well established, that very slight differences exist in the relative earliness of most of the extra early varieties.

The most productive of the above varieties were, Premier Extra Early, Alaska and Bergen Fleetwing.

Peppers.—Red Cluster, (*Hend.*;) and Japanese Cluster, (*Cowan*;) are identical. Red Upright, (*Land.*;) was the most prolific of the large peppers. Celestial is worth growing for its beautiful, ornamental red, yellow and purple fruits, produced on the same plant.

Pumpkin.—The only pumpkins that produced more than two or three small fruits per vine, were Monmouth County Golden, Orange Cream and Nantucket, which were all quite prolific.

Radish.—These notes can be best given in tabular form as on the next page.

Among the thirty names in the table, we find ten that can be referred to one variety, the well known old Early Scarlet Turnip.

In some cases slight differences can be detected, which may denote different strains, as it was noted on May 8th the date upon which most of the early varieties became edible, that Nos. 703, 709, 710 and 720 were a little larger than the others; but as the difference was very slight it may be only accidental.

This test further emphasized the already well-proven fact that there is no essential difference in the many so-called first early varieties of our common kinds of vegetables.

Squash.—Of the Fall and Winter varieties, the Pineapple was the most prolific.

TABLE XII.—*Comparison of Varieties of Radishes.*

Garden No.	Name of Variety.	Seed from	Date Vegetated	Date Edible.	Remarks.
700	Beckert's Chartier.....	Greg.	April 5..	May 13..	Same as No. 730, but No. 701 is the best stock of seed.
701	Chartier.....	Til.	" 5..	" 13..	
702	Boston Long Scarlet.....	Greg.	" 4..	" 8..	
703	Earliest Scarlet Button.....	Burp.	" 4..	" 8..	Good, long and slender (see No. 714).
704	Cardinal Globe.....	Til.	" 4..	" 8..	These, with Nos. 709, 710 and 711 are practically the same, or, at most, strains of the same variety, the Early Scarlet Turnip.
705	Carmine Early Forcing.....	Cowan.	" 5..	" 8..	
706	Deep Scarlet Turnip.....	Thor.	" 4..	" 8..	
707	E'st Erfurt Scarlet.....	Buist.....	" 5..	" 8..	
708	Early Scarlet Globe.....	"	" 4..	" 8..	Smallest and lightest colored of its class.
709	" Turnip.....	Thor.	" 5..	" 8..	
710	" Prussian.....	Land.....	" 5..	" 8..	Same as Nos. 703 to 707.
711	Ex. Early Roman Carmine.....	Thor.	" 5..	" 8..	
712	Garnet Turnip.....	Land. ....	.....	" 8..	Same as No. 715, but a poorer strain.
713	Golden Yel. Sum. Turnip.....	Greg.	April 5..	" 13..	A little thicker and shorter than No. 702.
714	Long Scarlet Short Top.....	Thor.	" 4..	" 8..	Differs from No. 712. only in being a better strain.
715	New Blood Red Turnip.....	"	" 3..	" 8..	Hardly differs from Nos. 703 to 707, &c. [good.]
716	New Ea. Crimson Olive.....	Wils. ....	.....	" 13..	Root a little more tapering than 724, but not as
717	Newcom.	J. & S.	April 5..	" 8..	Differs little, if any, from Early White Turnip.
718	Phil. White Box.....	"	" 4..	" 8..	Much the same as No. 708 and 722.
719	Red Rocket.....	Hend.	" 3..	" 8..	Same as Nos. 703 to 707, &c.
720	Twenty-Day Forcing.....	Salz.....	" 5..	" 13..	Roots a little smaller than those of No. 730.
721	Shepherd.....	Til. ....	.....	" 8..	A little more regular than 708 and 719.
722	Startle.....	J. & S.	" 4..	" 8..	

TABLE XII.—CONTINUED. *Comparison of Varieties of Radishes.*

723	Sutton's Rosy Gem.....	Til.....	April 4..	May 8..	Scarlet Turnip, White Tipped.
724	The 1834.....	Maule.....	" 5..	" 15..	The best of the White Radishes.
725	Vaughan's Market.....	Vaugh.....	.....	.....	Same shape as No. 724, but smaller and poorer in every respect.
726	Violet, Wh't Tipped.....	Hend.....	.....	May 8..	Worthless. Skin badly discolored; very small.
727	White Lady Finger.....	Land.....	April 4..	.....	Not valuable.
728	Wood's Frane.....	Hend.....	" 5..	May 8..	One of the very best on the list.
730	Iowa Beauty.....	Agri'l Dept.	" 4..	" 15..	Same as Chartier, Nos. 700 and 701.

Turnips.—The following table of yields, on page 65, speaks for itself. The seed was planted on July 18th in rows 3½ feet apart and the young plants were somewhat slow in recovering from the attack of the flea-beetle. The weights were taken November 26th.

TABLE XIII.—*Comparison of Varieties of Turnips.*

Garden No.	Variety.	Seed from	No. of Roots	Weight of Roots in lbs.	Average weight per Root in ozs.	Remarks.
931	La Crosse, Early,.....	Salz.....	20	33	26.4	Does not differ from Red Top Strapleaf.
932	Red Top Strapleaf.....	Thor.....	20	31	24.8	
933	White Lily.....	Salz.....	20	33.5	26.8	White, variable in form, somewhat globe shape.
934	Green Barrel.....	Thor.....	20	35.5	28.4	White, with green top, flatter than 933.
935	Red Top Olive,	Land.....	20	36	28.8	White, with red top, shape flattened globular.
936	Snowball	Heud.....	20	31	24.8	
937	Milk Globe.....	Salz.....	20	32.5	26.0	Much like 936, but a little flatter.
938	Red Top Globe.....	Buist.....	20	49	39.2	A fine turnip, not quite as round as 935.
939	White Model.....	Hallock ..	7	8.5	19.4	Very irregular in size.
940	Yellow Aberdeen.....	Thor.....	14	19	21.7	Very irregular in size, color yellow.
941	Yellow Stone.....	Thor.....	10	17.5	28.0	Deeper color than 940.

VII.—ORCHARD AND SMALL FRUITS.

The past season has proved a favorable one for the young trees in the orchard, which were set in the Fall of 1888. A list of the varieties was given in Bulletin No. 4. The trees are now well established and in condition to make a vigorous growth next season, with favorable climatic conditions.

In the early Spring it was noticeable that the northern grown trees leaved out somewhat earlier than the southern grown, a fact which may be due to an inbred habit of commencing growth at a lower temperature. At an examination of the trees, early in July, it was found that many of them had been attacked by "rust," and very marked differences were seen in the amount of rust on the leaves of the different varieties, some being practically free from it while in others the leaves were nearly covered with the spots. Before giving any more definite notes on this subject we wish to make further observations.

Strawberries, raspberries and blackberries have all made good growth during the season, and the prospect for a crop of the former, next year, is excellent. In very few varieties is the stand at all broken.

REPORT OF THE CHEMIST.

BY HARRY J. PATTERSON, B. S.

I.—IN GENERAL.

The following is my annual report on the character and extent of the work of this department for the year 1889.

The laboratory and its equipment as described in last year's report has proven well adapted to our work and adequate for it thus far. The amount expended in this department for the year has been for the ordinary supplies; except the purchase of an "Excelsior Drug Mill" imported from Germany, which will greatly facilitate the work of preparation of fodder samples.

During the year, 488 samples have been received in the laboratory. The analyses of most of these samples have been completed and on all of them some work has been done. They are thus classified; tomatoes 356, fertilizing materials 47, marls 32, soils 24, fodders 22, butters 3, and miscellaneous 4. The results and discussions of the same follow this.

II.—THE CHEMICAL COMPOSITION OF TOMATOES.

In connection with the general study of the tomato, undertaken at the Station for the past year, a thorough chemical investigation was instituted. This was the more necessary because nothing of consequence could be found on record, relating to the chemistry of the tomato.

The inquiry has extended not only to the general chemical composition of this fruit, or vegetable, but has included the effects produced by a variation of conditions and the application of different classes of fertilizers. The improvements of the tomato, and the creation of new varieties, have generally resulted from the efforts of horticulturists, working through the channels of hybridization and selection. Among the changes wrought are the marked differences in color, taste and flavor; and it is desirable to know how far these are due to changes in their chemical composition.

It is evident that the tomato cannot be valued as a nutritious food. It is so poor in nutritive elements, that its value must depend upon those constituents which gratify the senses of sight, taste and smell, promote appetite, aid digestion and in other ways contribute to health and pleasure.

Accordingly, it was decided not to analyze the tomatoes generally as foods and fodders are treated but to determine in their examination; the water, the dry substance, the ash, the sugar (glucose and like behaving substances), the free acids and the solids soluble in water.

There being no established mode of procedure in work of this kind it is necessary to describe the methods used.

SAMPLING.—The sample to be used in the laboratory was carefully selected to represent the average of the variety and picking. Every tomato was carefully wiped to free it of any dirt and sand adhering to its surface. Part of the sample was then chopped up fine and thoroughly mixed.

WATER AND DRY SUBSTANCE.—The other portion of the tomatoes of the selected sample was cut in half and placed in the drying closet which was heated by steam and maintained a temperature of from 50° C., to 65° C., and reduced to the air dry condition. This sample was then ground so as to pass through a 40-mesh sieve and the final moisture determined by heating in an air oven at a temperature of 100° C., for five hours.

SUGARS.—For this determination 50 grammes of the fine and mixed fresh tomatoes was placed in a graduated flask with 200 cubic centimeters of water, this was brought to a boil, then cooled and made up to 500 cubic centimeters. The solution was filtered and the sugar determined by means of "Fehling's Solution."

FREE ACIDS.—These were determined in the same solution used in the determination of sugar. 20 cubic centimeters of the solution being titrated with deci-normal soda, phenolphthalein being used as the indicator. The results were calculated as malic acid.

SOLIDS SOLUBLE IN WATER.—Five cubic centimeters of the same solution was placed in a porcelain crucible, a few drops of alcohol added to make the residue more cellular, and the whole evaporated to dryness and finally dried in the air oven for three hours at 105° C.

ASH.—This was determined after the method adopted by the American Association of Agricultural Chemists.

SUGARS AND ACIDS.

Two classes of sugars commonly occur in fruits and vegetables in varying proportions; the one, the glucoses (detrose or grape sugar and levulose or fruit sugar); the other, cane sugar or sucrose. The two differ from each other markedly in their behavior towards "Fehling's Solution."

A few samples of tomatoes were examined for both classes of sugars, the glucose being determined in solutions made up without the application of heat; and then a portion of this solution was made up in the usual manner for the cane sugar determinations. The amount of increase indicating cane sugar was so small that it was thought to be probably due to substances of a gummy or pectose nature which are well understood to form sugars which act on "Fehling's Solution" when treated with mineral acids. And from the amount of free acid in the tomato, cane sugar would not be likely to exist to any extent. For these reasons glucose only was determined in the main investigation.

On following the schemes for the detection of organic acids as given in Fresenius's Qualitative Analyses, paragraph 193, page 342, and Prescott's Organic Analyses, page 336; the following acids were found to be present, in the concentrated juice of the tomato, viz: Malic, Tartaric, Benzoic and Formic. Malic acid predominated and the others appeared to be present in very small quantities, and as there has been no time for a further investigation as to the relative amounts of these, the whole of the free acid has been calculated as malic acid.

The following table (No. I) gives the results of the various constituents determined in the different varieties.

TABLE No. I.

Chemical Composition of Tomatoes, by Varieties.

Garden No.	Name of Variety.	Water.	Dry Substance.	Ash.	Sugar.	Malic Acid.	Solids Soluble in Water.
800	Acme	96.30	3.70	0.39	3.31	1.18	4.06
801	Advance	96.38	3.62	0.41	2.94	0.92	3.83
802	Alpha, goods	96.01	3.99	0.45	3.09	1.20	3.84
803	Annie Dine	95.55	4.45	0.40	3.05	0.90	3.86
804	Atlantic Prize	96.40	3.60	0.36	2.74	1.04	3.92
805	Bay State	96.09	3.91	0.39	2.66	1.74	3.60
806	Beauty	96.31	3.69	0.32	2.64	.84	3.40
807	Belle	96.41	3.59	0.35	2.86	1.37	4.02
808	Bermuda Ex. Ey.	96.39	3.61	0.40	2.63	1.14	3.88
809	Brandywine	96.04	3.96	0.33	3.33	1.20	4.35
810	Bronzed-leaved	96.04	3.96	0.39	2.99	0.90	3.90
811	Buist's Beauty	95.48	4.52	0.44	3.38	0.97	4.10
812	Cardinal	96.18	3.82	0.36	2.97	0.92	4.40
813	Cincinnati Purple	95.66	4.34	0.49	2.50	1.44	4.00
814	Climax	95.92	4.08	0.37	3.52	0.94	4.10
815	Conqueror	96.00	4.00	0.49	2.61	0.92	3.43
816	Earliest of All	95.88	4.12	0.45	2.57	1.09	3.70
817	Early Jersey	95.86	4.14	0.42	3.22	0.80	4.10
818	Essex Hybrid	95.92	4.08	0.40	3.19	0.97	4.33
819	Ex. Ey. Advance	96.80	3.20	0.44	2.41	1.04	3.65
820	Faultless	96.52	3.48	0.43	2.76	1.09	3.85
821	Favorite	96.40	3.60	0.40	2.97	0.74	3.90
822	Gen'l McClellan	96.81	3.19	0.38	2.54	0.50	3.60
823	Golden Trophy	95.38	4.62	0.45	3.52	0.90	4.20
824	Golden Queen	96.79	3.21	0.44	2.36	1.27	3.80
826	Hundred Day	96.16	3.84	0.40	2.75	1.05	4.02
827	Imp. Large Yellow	95.53	4.47	0.45	3.40	1.17	4.56
828	Ivory Ball	95.84	4.16	0.41	3.33	1.14	4.36
829	King Humbert	96.33	3.67	0.43	2.70	0.67	3.40
830	Large Yellow	95.53	4.47	0.45	2.79	0.83	3.96
831	Lorillard	96.43	3.57	0.42	2.78	0.80	3.40
832	Matchless	96.24	3.76	0.43	.....	.....	.....
833	McCullom's Hybrid	96.07	3.93	0.62	2.94	1.27	4.30
834	Mikado	95.95	4.05	0.32	3.22	1.01	3.60
835	Mikado, (different seed) ..	96.18	3.82	0.45	3.33	0.87	4.30
836	Morning Star	96.26	3.74	0.48	2.74	0.77	3.60
837	New Jersey	95.91	4.09	0.33	3.49	1.11	4.30
838	New Queen	95.81	4.19	0.44	3.14	0.88	4.33
839	New White Apple	96.40	3.60	0.43	1.79	1.44	3.40
840	Optimus	96.16	3.84	0.34	3.22	0.90	4.00
841	Paragon	95.78	4.22	0.37	3.38	1.04	4.30
842	Paragon, (different seed) ..	96.06	3.94	0.42	3.45	0.97	3.84
843	Peach	96.44	3.56	0.40	2.93	1.18	3.78
844	Perfect Gem	96.06	3.94	0.39	3.09	1.54	4.50

TABLE No. I.—Continued.

Chemical Composition of Tomatoes, by Varieties.

Garden No.	Name of Variety.	Water.	Dry Substance.	Ash.	Sugar.	Malic Acid.	Solids Soluble in Water.
845	Perfection.....	95.81	4.19	0.37	3.30	0.86	4.00
846	Potato Leaf.....	96.30	3.70	0.35	2.96	0.67	3.60
847	Prize Belle.....	95.98	4.02	0.32	3.22	1.11	4.20
848	Prize Belle, (different seed)	96.49	3.51	0.46	2.33	.....	3.74
849	Puritan.....	96.32	3.68	0.34	3.16	0.94	4.00
850	Red Apple.....	96.30	3.70	0.47	1.76	.....	3.02
851	Scoville's Hybrid.....	96.58	3.42	0.45	1.89	1.44	2.90
852	Station.....	.....	.....	.....	.....	.....	.....
853	Sunrise Yellow.....	96.26	3.74	0.32	2.84	0.80	3.70
854	Shah.....	95.98	4.02	0.38	3.17	0.76	3.70
855	Tree (Dwarf Champion)...	96.36	3.64	0.37	2.86	1.01	3.90
856	Tree.....	.....	.....	.....	.....	.....	.....
857	Trophy.....	96.05	3.95	0.41	3.00	1.03	4.16
858	Turner Hybrid.....	96.30	3.70	0.44	2.38	1.54	3.60
859	Turner Hybrid.....	96.18	3.82	0.41	.....	1.07	.....
860	Volunteer.....	96.86	3.14	0.35	.....	1.54	.....
861	Haines, No. 64.....	96.16	3.84	0.40	7.75	1.05	3.51
862	Fire King.....	96.02	3.98	0.44	.....	1.44	.....
863	Ignotum.....	96.89	3.11	0.44	2.42	1.14	3.40
864	Wonder of Italy.....	96.14	3.86	0.44	2.79	0.77	3.40
865	Early Puritan.....	96.30	3.10	0.38	3.09	1.07	3.86
866	Fulton Market.....	96.07	3.93	0.41	3.24	1.07	4.00

From a general study of these results it will be noticed that the amounts of sugar and dry substance agree so closely that it indicates that either the one is too high or the other too low and probably there is a slight error in each direction.

From the general behavior of the tomato and its appearance after drying, there are strong indications of an appreciable loss of something in the drying process other than water, and a further investigation of this point will be conducted. But this will not affect the comparison of the results with each other, as the samples were uniformly treated.

The range in amount of dry substance is one and a half per cent.; this is a good deal, considering the relatively small amount present in the tomato. The range of sugars and acids are about in the same proportion.

In most cases when the acid runs higher than the average, the sugar content is below the average, and vice versa. The yellow tomatoes have a slightly higher content of dry matter than the red. The content of sugar in the yellow tomatoes is a little higher and the acid a little lower, than in the red tomatoes, though there is not as much difference in this respect as is generally supposed to exist.

The chemical composition of the tomato is a poor index in itself of the general desirability of a variety. It may indicate more plainly than any other means the flavor and general palatableness of the product, but these are such small factors in relation to the mass of the product, that it is necessary in making up the conclusions, to consider the yield of the variety as well as the composition.

A calculation of the amount of dry substance and sugar with reference to the yields, place the varieties in about the same order as given in the Horticulturist's Report, p.

If there is sufficient demand for a rapid method for the determination of the dry matter in tomatoes, so that canners or packers could buy, and farmers sell, on this basis, such a method could be given, by which the determination could be made in five or ten minutes time.

The figures in the table of varieties, are the averages resulting from the examination of from two to fourteen samples of each variety named.

As a matter of information, regular food analyses were made of several samples from a number of varieties of tomatoes and the following table (No. II) gives the water and dry substance as found and the percentage of food constituents in the dry substance.

For an explanation of the terms at heads of columns in Table No. II, see Bulletin No. 3, pages 35 and 38.

If we reduce the averages of Table No. II to the basis corresponding to the fresh fruit, which is done by multiplying the per cent. of dry substance by the per cent. of each constituent, we have the following statement of the

TABLE No. II.—*Showing the Food Constituents of the Tomato.*

Sample No.	Water.	Dry Substance	Water-free Substance.					Albuminoid Nitrogen.
			Ash.	Fat.	Protein.	Crude Fibre.	N.-free Extract.	
806	96.31	3.69	8.07	11.09	19.65	16.85	44.34	3.13
826	96.16	3.84	8.10	11.65	22.66	16.50	41.09	3.62
830 (1)	95.53	4.47	7.24	9.45	20.18	14.79	48.34	3.23
838 ..	95.81	4.19	8.26	10.37	21.43	14.54	45.40	3.43
854 (1)	95.98	4.02	8.92	9.29	19.02	14.38	48.39	3.04
857	96.65	3.05	11.32	7.75	19.19	15.34	46.40	3.07
Average	95.97	4.03	8.65	9.93	20.36	15.40	45.66	3.25
								2.47
								1.68
								2.50
								2.40
								1.80
								2.43

(1) Nos. 830 and 854 are Yellow Tomatoes.

actual amounts of the different constituents of the tomato, averaging the varieties indicated.

Water.....	95.97	per cent.
Dry Substance	4.03	"
Ash.....	0.35	"
Fat (Ether Extract).....	0.40	"
Protein.....	0.82	"
Crude Fiber... ..	0.62	"
Nitrogen free Extract (Carbohydrates)	1.84	"

The above table shows quite a regular variation between the red and yellow tomatoes. The red tomatoes are poorer in dry substance, but this dry substance is richer in the more valuable food constituents. Also there is a noticeable difference in the relative amounts of nitrogen in the albuminoid form—it being much less in the yellow tomatoes.

III.—THE EFFECT OF FERTILIZERS ON THE COMPOSITION OF TOMATOES.

For the purpose of studying the effect of fertilizers on the composition of the tomato, two varieties from the fertilizer plots were selected and samples from three pickings of each of these varieties were taken for analysis; the same ingredients were determined as in the variety tests. Table No. III, on the next page, gives the average results for each variety:

To give these results in a more condensed form and to eliminate possible errors in drawing conclusions from a single variety, the average composition of the two varieties, and the treatment of the plots are shown in Table No. IV, on page 76.

From the above it will be seen that there is no marked difference in the composition of tomatoes grown with different fertilizers. Yet the variation is enough to indicate the following as probably true:

1st. That potash has the effect of producing a fruit with more dry substance accompanied by a slight decrease in the sugar and an increase in the acid. This, when considered in connection with increase of yield, is favorable to the use of potash.

TABLE No. III.—*Composition of Tomatoes from Differently Fertilized Plots.*

Plot No.	Hundred Day (826).				Trophy (857).					
	Water.	Dry Sub-stance.	Ash.	Sugar.	Malic Acid.	Water.	Dry Sub-stance.	Ash.	Sugar.	Malic Acid.
I.....	95.89	4.11	0.43	2.64	1.22	95.52	4.48	0.35	3.19	0.99
II.....	95.98	4.02	0.35	2.64	0.95	95.62	4.38	0.34	3.12	1.10
III.....	95.74	4.26	0.34	2.68	1.11	95.72	4.28	0.32	3.19	0.93
IV.....	95.75	4.25	0.34	2.64	1.01	95.25	4.75	0.33	3.18	1.12
V.....	95.58	4.42	0.37	2.82	1.19	95.40	4.60	0.40	3.45	0.96
*VI.....						95.67	4.33	0.44	3.13	0.80
VII.....	95.46	4.54	0.42	3.03	1.18	95.67	4.33	0.35	3.27	0.99
VIII.....	95.27	4.73	0.46	2.54	1.32	94.94	5.06	0.42	3.39	0.92
IX.....	94.70	5.30	0.44	2.88	1.47	96.21	3.79	0.27	3.36	0.98
X.....	95.10	4.90	0.48	2.54	1.59	94.86	5.14	0.42	3.34	1.21
XI.....	95.22	4.78	0.50	2.61	1.35	95.56	4.44	0.43	3.27	1.11
XII.....	95.92	4.08	0.44	2.45	1.40	94.64	5.36	0.44	3.09	1.22

* The variety on this plot proved not to be the same as on the other plots.

TABLE No. IV.—Average Composition of Tomatoes from Plots differently Manured.

Plot No.	Name of Fertilizer.	Quantity of Fertilizer per acre. LBS.	Average Composition of Tomatoes.			
			Water.	Dry Substance	Ash.	Sugar. Malic Acid.
I.....	Nitrate of Soda.....	160	95.70	4.30	0.39	2.92
II.....	Dried Blood.....	240	95.80	4.20	0.35	2.88
III.....	Dissolved Bone Black.....	320	95.73	4.27	0.33	2.94
IV.....	Nothing.....	.....	95.50	4.50	0.34	2.91
V.....	{ Muriate of Potash.....	{ 160	{ 95.49	{ 4.51	{ 0.39	{ 3.13
	{ Nitrate of Soda.....	{ 160				
VI.....	{ Dissolved Bone Black.....	{ 320	{ 95.67	{ 4.33	{ 0.44	{ 3.13
	{ Nitrate of Soda.....	{ 160				
VII.....	{ Dissolved Bone Black.....	{ 640	{ 95.56	{ 4.44	{ 0.39	{ 3.15
	{ Nitrate of Soda.....	{ 160	{ 95.10	{ 4.90	{ 0.44	{ 2.97
VIII.....	{ Muriate of Potash.....	{ 160	{ 95.45	{ 4.55	{ 0.36	{ 3.12
IX.....	{ Nothing.....	{ }	{ 94.98	{ 5.02	{ 0.45	{ 2.94
X.....	{ Nitrate of Soda.....	{ 160				
	{ Muriate of Potash.....	{ 320				
XI.....	{ Dissolved Bone Black.....	{ 320	{ 95.38	{ 4.62	{ 0.46	{ 2.94
	{ Nitrate of Soda.....	{ 160				
XII.....	{ Muriate of Potash.....	{ 160	{ 95.28	{ 4.72	{ 0.44	{ 2.77
	{ Nitrate of Soda.....	{ 160				

2d. That nitrates and phosphoric acid have a tendency to produce a fruit with more than the average proportion of water, but with more sugar and less acid than those grown with potash.

3d. The sweetest tomatoes were produced on the plots receiving phosphoric acid.

It must be noted, however, that the differences are so slight as to furnish only indications and preclude the use of the word "conclusions." Moreover, the facts recorded in these tables were obtained in an exceptional season, which probably had some influence upon all our plot work in 1889. An effort was made to determine the effect of changing weather upon the tomato.

IV. TOMATO VARIATION AND WEATHER CHANGES.

It is a common remark that tomatoes are sweet or sour according as the season has been a dry one or wet one.

To ascertain the relation between the composition of the tomato and changing meteorological conditions, twelve varieties of tomatoes were chosen and samples from each picking during the most productive part of the season were analyzed. Records of the air temperature, the rainfall and the sunshine were made for the same period. The following table gives the averages of these records.

TABLE No. V.

Prevailing Weather and Corresponding Tomato Composition during the Ripening Season, 1889.

Date.	Mean temperature for period.	Rainfall for period.	Mean sunshine for period.	Average moisture of samples.	Average sugar of samples.	Average acid of samples.	Average yield per picking in ounces.
			H. M.				
July 18.....	72.4	.00	10.32	94.75	.....	.....	5.0
" 22.....	74.2	.11	6.17	96.59	3.04	0.52	3.8
" 25.....	69.6	.03	5.11	96.77	3.01	1.16	16.3
" 29.....	72.9	1.34	2.21	96.74	2.89	1.08	29.7
Aug 1.....	72.6	3.48	none.	96.77	3.10	1.01	38.5
" 5.....	75.9	.05	none.	96.41	2.89	0.99	295.0
" 8.....	70.2	.06	5.17	96.30	2.94	1.09	94.8
" 12.....	69.8	.64	4. 8	95.22	2.98	0.94	62.4
" 15.....	72.7	.00	2.36	95.23	3.03	0.99	185.7
" 19.....	67.1	.00	5.49	96.28	2.83	1.08	174.6
" 22.....	73.9	.01	5. 3	95.32	3.04	1.12	141.0
" 26.....	69.9	.54	3.52	96.28	2.84	1.15	225.4
" 29.....	67.4	.00	6.41	95.31	2.70	1.03	70.3
Sept. 2.....	69.9	.02	5.51	95.14	3.01	1.04	251.8

The figures on July 18th represent averages for the four days next preceding, and on the other dates, the averages for the days since the record next before.

An examination of this table shows the following points:

1st. That the variation in composition agrees closer with the variation in temperature than with the relative rainfall or sunshine.

2d. That the highest water content of the tomato follows closely the periods of highest rainfall; but the range does not seem in any way proportional.

3d. That the highest sugar content is either on or following the periods of greatest rainfall.

4th. That the rate of yield or ripening depends more on the temperature and amount of rainfall than on the actual duration of sunshine; but the latter seems to exert a decided influence in some periods.

V.--COMPARISON OF METHODS OF DETERMINING SUGAR AND ACIDS IN THE FRESH AND AIR-DRY SUBSTANCE OF THE TOMATO.

In the course of our laboratory work the question arose, as to whether it was necessary to determine the sugar and acid of the tomato while fresh picked, in an edible condition, or whether this might not be done later, by an examination of the air-dry substance of the fruit.

To test this question, samples were taken from six varieties, half being examined fresh and duplicates dried and analyzed later. These were very uniform fruits and those dried remained in excellent condition till examined.

The table at the top of the next page gives the results obtained, calculated to a water-free basis.

It is very evident from this table that there is a loss or change of both sugar and acids in the process of drying which prevents them from being correctly determined in the dry substance. The plan first adopted of examining the tomatoes while fresh was thus fully confirmed as correct.

TABLE No. VI.

Comparative Laboratory Methods for Testing Tomatoes.

Index No.	Acids.			Sugar.			Proportion of Acid to Sugar. Dry substance.	Proportion of Acid to Sugar. Fresh substance.
	Dry substance.	Fresh substance.	Proportionate yields.	Dry substance.	Fresh substance.	Proportionate yields.		
511	7.28	18.87	1:2.59	28.92	61.08	1:2.11	1:3.97	1:3.23
512	10.03	20.73	1:2.06	24.27	54.27	1:2.23	1:2.41	1:2.61
513	8.82	23.73	1:2.59	26.94	65.72	1:2.43	1:3.05	1:2.77
514	10.17	28.13	1:2.77	18.59	56.67	1:3.05	1:1.82	1:2.01
515	5.99	16.22	1:2.71	25.20	73.46	1:2.91	1:4.21	1:4.52
516	9.09	20.84	1:2.29	34.30	59.92	1:1.74	1:3.78	1:2.87

VI. MARLS.

Marls are found in large quantities in many parts of Maryland, and have been used more or less for agricultural purposes for many years.

From the small quantity of plant foods which marls furnish and the difficulty and expense of handling and transportation, their use is necessarily confined to places very near the deposits.

Marls are divided into three classes, according to their general character and the geological formation to which they belong. As a rule they are to be found one above the other in immediate succession. The upper layer is known as shell marl, or blue marl, and is generally found at or very near the surface. It consists chiefly of sea mud with partially decayed shells and bones. Its value depends mainly on lime, which it contains in the form of the carbonate. This class of marl usually has a small per cent. of phosphoric acid and potash. The physical character of calcareous marls varies with the class of animal remains

from which they are derived and the state of preservation of the same. To this class belong most of the marls that have been examined at this Station.

The second class of marl is known as chalky or eocene marl, is commonly a coarse kind of friable chalk, consisting of comminuted shells and corals, of a light yellowish or grayish color. The main agricultural value of this variety is in the carbonate of lime which it furnishes, but it also has a small per cent. of phosphoric acid and potash. There are deposits of this kind of marl on the Eastern Shore of Maryland. Sample No. 83 was of this kind.

The third class, or that which lies at the bottom, is the cretaceous marl, and is commonly known as "green sand" in New Jersey. Marls of this class vary considerably in their chemical composition and agricultural value. They owe their fertilizing quality to the presence of phosphoric acid and potash, but sometimes contain a goodly admixture of calcareous matter. The best New Jersey marls and those that have been used with the most success have contained from two to three per cent. phosphoric acid and from five to seven per cent. of potash. The Maryland marls of this class that have been examined here, thus far, have not given nearly as high a per cent. of these ingredients.

The potash of marls being in an insoluble form it must necessarily give its returns but slowly. With the object of getting some cheap method of converting the potash to a form more available to plants, this Station has now in progress a series of experiments in the composting of marls.

Expecting in the future to give a more extended and detailed discussion of marls, their composition and the extent of the deposits, we will now simply give a brief description of the samples already examined and the plant food they have been found to contain.

Index No. 35.—Sent by H. M. Murray, Esq., of West River, Md. Taken from upper layer of marl; this layer is about seven feet thick and is covered by a layer of yellow clay eight feet thick. The whole deposit is in a slight elevation between two marshes, and is about 250 feet in width. Trees are growing on this elevation.

No. 36.—Sent by H. M. Murray, Esq., of West River, Md. Sample taken from layer under that of sample No. 35; this layer is about five feet thick.

No. 37.—Sent by H. M. Murray, Esq., of West River, Md. Sample taken from layer under sample No. 36; this layer is about forty feet thick.

No. 38.—Sent by Richard Baldwin, Esq., Waterbury, Md. Taken from a deposit near a stream; greenish sandy appearance with some micaceous looking particles.

Nos. 42 and 43.—Sent by Spear & Critcher, of Glymont, Md. These are mixtures of spiral shells and a greenish sand, having about 54 per cent. (by weight) of sand. Deposits are quite extensive and within easy reach of the Potomac river.

No. 49.—Sent by Fred. Sasscer, Jr., of Upper Marlborough, Md. Taken from bank along roadside; stratum about six feet thick, lying horizontal on stratum of dark clay.

No. 50.—Sent by Fred. Sasscer, Jr., of Upper Marlborough, Md. Taken from a place about one-half mile from where sample No. 49 was gotten and from under a large rock.

No. 54.—Sent by L. B. Johnson, Esq., of Piscataway, Md. Taken from deposit in neighborhood of Piscataway and Fort Washington, on the Potomac river, at the terminus of the plateau often called "The Backbone of Prince George's County;" soil above deposit is principally clay and gravel; the strata is very deep and where exposed it has a very hard crust about three inches in thickness; spiral shells abundant.

No. 55.—Sent by L. B. Johnson, Esq., of Piscataway, Md. Taken from deposit about one mile from where No. 54 was gotten; general characters the same, except the hard top layer is absent.

No. 83.—Sent by Dr. Charles Lowndes, of Easton, Md. Deposit is on the "Dundee Farm," near a small stream

which runs through the place. The layer is about two feet below surface and is four feet thick.

No. 93.—Sent by George Taylor, Esq., of Glymont, Md. Description about same as samples 42 and 43

No. 447.—Sent by J. A. Cunningham, Esq., Friendship, Md. Marl of light brown color and contains a good many partially decomposed shells.

No. 448.—Sent by P. H. Prout, Esq., Friendship, Md. Marl of light brown color containing micaceous specks.

Nos. 449 to 453 inclusive.—Sent by J. A. Wood, of Friendship, Md. No. 449 is from top layer, of sandy appearance, containing no shells and is about eight feet below surface.

No. 450.—Taken from layer about two and one-half feet below sample 449. Found petrified vertebra in this.

No. 451.—Taken from layer under sample 450. Made up of small shells; layer about one and one-half feet thick.

No. 452.—Taken from layer under sample 451. Made up of large shells resembling oyster and clam shells; layer about four feet thick, and is underlaid by rock.

No. 453.—Rock found on surface appeared to be made up of shells.

No. 454.—Sent by L. M. K. Griffith, of Dunkirk, Md. Taken from along edge of stream; layer about four feet under surface. No shells in this layer.

No. 455.—Taken from layer under sample 454. Made up mostly of large shells.

No. 456.—Sent by L. M. K. Griffith, of Dunkirk, Md. Taken from his Lyon's Creek Place, on the Patuxent river. Layer about forty feet thick and contains no shells, but an under layer has shells.

No. 457.—Similar to sample No. 456, but taken from a place about fifty rods farther down the stream.

No. 459.—Sent by L. M. K. Griffith. Shell rock very hard in centre, but decomposing on surface; taken from near extensive infusorial earth deposits.

No. 461.—Sent by Edward L. F. Harcastle, of Lee

Haven, Md. Layer about seven feet thick and twelve feet below surface; made up of small shells.

No. 462.—Layer under sample 461. Made up principally of clam shells.

TABLE No. VII.
COMPOSITION OF MARYLAND MARLS.
Per Cent. in Air-Dry Samples.

Index		Insoluble	Lime	Phosphoric	
No.	Water.	Residue.	(Ca O.)	Acid.	Potash.
35—	3.43	68.50	0.38	0.58	3.22
36—	8.44	63.77	0.25	0.32	3.02
37—	4.28	68.45	0.25	0.34	3.52
38—	2.45	89.02	....	0.08	0.25
42—	0.98	46.12	31.94	0.14	0.49
43—	1.06	62.71	17.22	0.05	0.59
49—	8.30	70.76	0.23	0.58	2.37
50—	0.54	60.51	14.71	0.12	1.89
54—	1.06	61.84	5.37	0.16	1.57
55—	0.88	44.71	9.00	0.24	2.08
83—	0.53	18.77	39.90	0.32	0.18
92—	11.04	67.70	1.88	0.30	1.78
447—	1.73	77.82	8.56	0.44	0.84
448—	1.08	82.67	8.00	0.26	0.28
449—	1.53	92.23	1.06	0.88	0.59
450—	0.83	92.19	1.00	0.52	0.23
451—	0.45	76.62	11.19	0.89	0.22
452—	0.12	80.28	9.50	0.14	0.42
453—	0.22	98.02	....	....	....
454—	0.35	83.37	4.25	1.74	0.44
455—	0.93	84.96	0.56	0.12	0.52
456—	2.18	81.86	trace	0.12	2.49
457—	0.90	80.04	"	0.30	2.40
459—	1.60	96.96	....	....	....
461—	0.53	38.39	28.37	0.22	0.43
462—	0.58	26.21	31.94	0.30	0.32

VII.—SOILS.

During the past year, a few samples of soil have been examined for their mineral plant foods, in hope that this might help in the study of some other questions. As a matter of record the description of the samples, with the results of the chemical investigation, as far as conducted, are given herewith.

As a rule, it is found that time spent in the chemical analysis of soils is practically wasted, and work of this kind is only undertaken at the Station when connected with and aiding some special line of inquiry.

No. 34. This sample was sent by the late Hon. A. B. Davis of Montgomery county, Maryland, and was taken from the bottom of a well that had been dug during the previous fall. This soil was believed to contain some specially noteworthy plant food, because of the luxuriant vegetable growth that sprang from it the following year. The examination proved that it contained a fair supply of potash, from decomposed feldspar.

Nos. 88, 89, 90 and 91. These samples were taken from the side of a cut about ten feet deep, on Filston Farm, owned by Mr. Edward Austen, near Glencoe, Baltimore county, and represented the differently appearing parts of what is known as the "rotten-rock soil" of that region. The samples were taken from the side of the bank at depths varying from three to six feet from the natural surface. They all belonged to the same general formation, but differed in color and somewhat in consistency, the latter owing to varied degrees of decomposition of the rock. No. 88 was of a dark chocolate color, running in irregular seams through the earth from 2 to 5 inches in thickness; it was in feeling sandy, with mica, and somewhat the character of soap-stone. These dark seams were more moist than the rest of the formation. No. 89 was brown, but lighter in color than 88, and more sandy, with the mica and soap-stone feeling much less marked; this sample represented the great bulk of the earth in the bank. Throughout the mass, were large seams of a

still lighter color, and much like white sand, the courses irregular rather than well defined strata, and from 3 to 10 inches thick; sample No. 90 represents this portion. No. 91 was a sample of deposits which occurred at intervals in the earth, varying in size and still in the form of rock, although partially decomposed. These deposits were greyish in color, with some brown shades and showed mica. Coming out of the ground in irregular fragments from the size of an oyster shell to that of a brick, these could be easily broken up in the hands.

Nos. 133 and 134 were taken in a large peach orchard belonging to Mr. John A. Nicodemus, at Edgemont, Washington county. The location is on the westerly slope of the South Mountain, and the soil is largely composed of finely broken slate mixed with other debris of the mountain sides, and not far below rocky and wooded cliffs. No. 133 was of a lighter color and called the "light slaty soil" of the neighborhood, and No. 134 was a little darker and called "black slaty soil." The former was taken from just beneath the surface in a portion of the orchard, fifteen years old, where "the yellows" had, within ten years, killed three generations of peach trees, on an area of two acres or more. The latter sample was similarly taken at the same altitude on the hillside, but forty or fifty rods farther south, where the peach trees had remained perfectly healthy during the same period of years.

The object of this examination was to see if any marked difference could be found in the soil, which might possibly account for the difference in the health of the trees. The result gives no light in that direction; the soils are practically the same, No. 133 being rather the stronger in plant food.

No. 463. Sent by Mr. J. M. Stover, of Edgemont, Washington county. This is a sample of surface soil taken at the time of setting in peach orchard, from land that is considered choice peach soil. Average sample from several different places in field to depth of six

inches. Land has not been manured for five years. This field is on the same hillside, but some distance below, the one from which the samples Nos. 133 and 134 came.

No. 464. Sub-soil of sample 463, second six inches in depth. An average sample from the different parts of the field taken in the same way.

No. 465. Sent by J. M. Stover, Esq., of Edgemont, Md., but taken near Martinsburg, Va. Land uncultivated for five or six years and regarded as particularly suited to fruit growing.

No. 466. Sent by J. M. Stover, Esq., of Edgemont, Md., taken from between several trees in advanced stages of yellows, in one of his orchards within a mile of the locality of samples No. 133 and No. 134.

No. 467. Sent by J. M. Stover, Esq., of Edgemont, Md., taken in same orchard as sample 466 but from among the healthy trees.

Land represented by sample 466 and 467 had been cultivated the same and for each of the past three years had received an application of 400 pounds per acre, of a mixture of raw bone and muriate of potash; also the past year, 20 bushels of lime per acre.

TABLE No. VIII.
COMPOSITION OF SOILS.
Per Cent in Air-Dry Sample.

Index No.	Water.	Insoluble Residue.	Lime (Ca O.)	Phosphoric Acid.	Potash.
34—	2.12	70.00		0.44	1.83
88—	1.90	66.79	0.31	0.54	1.88
89—	0.80	93.33	0.19	0.08	0.63
90—	0.32	94.25	0.37	0.08	0.71
91—	0.20	96.24	trace	trace	0.44
133—	2.48	83.66	0.56	0.50	0.55
134—	5.33	83.90	0.56	0.32	0.35
463—	1.40	85.61	0.31	0.24	0.45
464—	0.85	87.92	0.50	0.16	0.42
465—	2.29	78.71	0.12	0.28	0.43
466—	0.50	92.21	0.56	0.20	0.22
467—	0.59	91.54	0.31	0.19	0.32

Good agricultural soils contain about one-half of one per cent. of phosphoric acid and from one-half to one per cent. of potash. It will therefore be seen that with the exception of samples 34 and 88, which were strong in potash, although by no means unusually so, there is no soil shown in the above table which is remarkable for its natural store of plant food. The most notable fact of the table is that the sample No. 467, from a field which during the last three years had received 1200 lbs. per acre of fertilizers rich in phosphoric acid and potash, and had been kept clear of all vegetation except peach trees, showed this soil to be poorer in the two elements of plant food named, than sample 463, from a field which had received no manure for five years, and sample 465, from land uncultivated for five or six years. Undoubtedly the land of No. 467 contained more available plant-food, than that of Nos. 463 and 465, yet the laboratory verdict is to the contrary. This is a good example of the uselessness of ordinary chemical analysis for the purpose of determining the "richness" of common soils.

VIII.—INVESTIGATION ON THE DETERMINATION OF MOISTURE IN AIR-DRY FEEDING STUFFS.

(This is a contribution to the study of laboratory methods and of little interest except to chemists and their helpers.)

We all recognize the fact that the determination of moisture is one of the most important operations connected with fodder analysis, from the fact that the correctness of all other determinations when reduced to a water-free basis depend on this determination.

A research of the literature on this subject, which is very scant, discloses the fact that the methods adopted and pursued have been in, but few cases the result of detailed experiments. They are dependent for their value on theoretical statements put down and used as if they were axiomatic facts.

Taking these facts in consideration, I began a little more than a year ago, an investigation of this subject, and

up to date have made over two thousand determinations in studying the various phases of the question. As yet, however, I have been unable to arrive at definite conclusions on all the points under consideration. So this is only a report of progress and I hope, at no distant date, to be able to finish it in a way satisfactory to myself and perhaps to the general analyst.

In the discussion of the question the following points have been under consideration :

1st. In what kind of a vessel shall we dry ?

2d. For what length of time ?

3d. At what temperature ?

4th. In what medium ?

5th. What is the nature of the substance (?) lost and the general change in the process of drying ?

In this discussion, wheat—flour, cotton-seed meal and corn fodder have been used as representing fairly well, the different classes of substance with which we meet in general practice. For special substances we propose to make a comparison, after some of the above questions have been decided, and ascertain if any modifications from the general manner of procedure are necessary.

In the consideration of the first question, (In what kind of a vessel shall we dry?) we have compared the only two that we have found mentioned or known to be in common use—the clamped watch-glasses and porcelain crucibles. For the second point (length of time) we have used two, four, five, six, eight and ten hours respectively. For the third (temperature,) we have used 100° C., 105° C., 110° C., 115° C., and 120° C. For the fourth (the medium,) a comparison has been made and is being continued between a current of dry and heated air, the simple air oven, a stream of hydrogen, and a stream of carbonic acid gas.

The results given in the following tables are the averages of triplicate determinations.

(Text continues on page 93.)

TABLE IX.

A Comparison of Drying in Different Vessels for Different Lengths of Time and at Different Temperatures, in the simple Air Oven.

	100°		105°		110°		115°		120°	
	Watch glasses.	Porcelain crucibles.	Watch glasses.	Porcelain crucibles.	Watch glasses.	Porcelain crucibles.	Watch glasses.	Porcelain crucibles.	Watch glasses.	Porcelain crucibles.
2 Hours.										
Wheat										
flour....	12.01	14.18	12.92	14.34	13.28	14.25	14.36	14.97	14.49	14.90
Cotton										
seed meal.	8.31	9.32	9.05	9.01	9.33	9.48	9.70	9.79	9.83	9.71
Corn										
fodder..	9.02	9.02	8.76	8.50	10.13	9.98	9.53	9.55	10.60	10.16
4 Hours.										
Wheat										
flour....	12.86	14.19	13.79	14.45	14.38	14.63	14.40	14.65	14.79	14.91
Cotton										
seed meal.	9.20	9.42	9.43	9.52	9.78	9.85	10.21	10.23	10.01	9.84
Corn										
fodder..	9.33	9.25	9.38	9.28	10.15	10.07	10.35	10.42	10.85	10.72
5 Hours.										
Wheat										
flour..	14.20	14.21	14.18	14.55	14.38	14.68	14.75	14.73	14.89	14.97
Cotton										
seed meal.	9.09	9.57	9.45	9.55	9.78	9.85	9.88	9.83	10.16	9.95
Corn										
fodder..	9.49	9.28	9.87	9.40	10.16	10.27	10.48	10.53	11.17	11.03
6 Hours.										
Wheat										
flour....	14.33	14.25	14.31	14.50	14.38	14.41	14.95	14.97	14.88	14.93
Cotton										
seed meal.	9.34	9.40	9.27	9.47	9.72	9.69	9.97	9.96	10.20	9.94
Corn										
fodder..	9.74	9.32	9.26	8.80	10.45	10.63	10.15	10.27	11.33	11.16
8 Hours.										
Wheat										
flour....	14.07	14.36	14.27	14.46	14.63	14.66	14.53	14.65	14.88	14.91
Cotton										
seed meal.	9.45	9.56	9.66	9.53	9.91	9.95	10.25	10.26	10.30	10.00
Corn										
fodder..	9.59	9.42	9.73	9.63	10.45	10.52	10.63	10.80	11.33	11.42
10 Hours.										
Wheat										
flour....	14.41	14.45	14.42	14.41	14.71	14.77	14.90	14.75	14.86	14.93
Cotton										
seed meal.	9.09	9.73	9.59	9.65	9.98	9.91	10.09	10.00	10.39	10.09
Corn										
fodder..	9.58	9.54	10.21	9.90	10.57	10.57	10.75	11.00	11.72	11.63

TABLE X.

COMPARISON OF DRYING IN DIFFERENT MEDIUMS.

A—A Current of Dry and Heated Air. B—The Simple Air Oven. C—A Stream of Hydrogen. D—A Stream of Carbonic Acid Gas.

	100°				105°				110°				115°				120°				
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	
2 Hours.																					
Wheat flour.....	13.06	14.18	12.16	12.73	13.47	14.34	12.63	13.35	13.53	14.25	14.59	14.63	....	14.97	11.82	12.07	13.85	14.90	12.07	12.78
Cotton seed meal....	8.05	9.32	8.06	8.58	8.16	9.01	8.88	9.15	8.83	9.48	9.99	8.74	....	9.79	8.30	8.89	8.80	9.71	8.55	9.24
Corn fodder.....	7.88	9.02	7.53	6.22	7.98	8.50	7.98	7.48	9.15	9.98	8.95	8.65	....	9.55	7.88	8.25	8.92	10.16	8.18	8.38
4 Hours.																					
Wheat flour.....	....	14.19	13.47	14.12	....	14.45	12.92	14.16	....	14.63	14.60	15.08	...	14.65	14.57	14.37	....	14.91	13.72	14.53
Cotton seed meal....	...	9.42	8.69	9.16	....	9.52	9.06	9.55	....	9.85	9.99	8.94	....	10.23	9.55	9.79	....	9.84	9.00	10.04
Corn fodder.....	..	9.25	8.47	8.62	....	9.28	8.15	8.95	....	10.07	9.02	8.98	....	10.42	8.90	8.87	....	10.72	8.88	9.12
5 Hours.																					
Wheat flour .....	....	14.21	13.72	14.03	....	14.55	13.02	14.32	....	14.68	14.44	15.31	....	14.73	14.52	14.54	....	14.97	13.89	14.60
Cotton seed meal....	....	9.57	8.77	9.16	....	9.55	9.12	9.47	....	9.85	9.93	9.10	....	9.83	9.61	9.84	..	9.95	9.69	9.99
Corn fodder .....	....	9.28	8.62	8.62	....	9.40	8.15	8.95	....	10.27	8.82	9.11	....	10.53	8.87	8.90	...	11.03	9.13	9.18
6 Hours.																					
Wheat flour	14.17	14.25	13.79	13.92	13.98	14.50	13.17	14.35	13.99	14.41	14.29	15.39	14.97	14.48	14.51	14.41	14.93	14.16	14.60
Cotton seed meal....	8.92	9.40	8.82	9.15	9.01	9.47	9.23	9.49	8.94	9.69	9.85	9.19	9.96	9.57	9.91	9.57	9.94	9.20	10.05
Corn fodder.....	8.35	9.32	8.62	8.55	9.75	8.80	8.10	8.85	9.45	10.63	8.83	9.18	10.27	8.73	8.92	9.10	11.16	9.03	9.45

8 Hours.																				
Wheat flour	14.36	13.87	14.28	...	14.46	13.40	14.51	....	14.66	14.31	15.51	....	14.65	14.76	14.66	....	14.91	14.33	14.74	
Cottonseed meal.....	9.56	8.89	9.36	....	9.53	9.35	9.58	....	9.95	9.83	9.38	....	10.26	9.65	9.08	....	10.00	9.33	10.19	
Corn fodder.....	9.42	8.62	8.93	....	9.63	8.22	9.05	...	10.52	8.85	9.48	....	10.80	8.90	8.92	....	11.42	9.15	9.45	
10 Hours.																				
Wheat flour.....	14.45	14.45	14.06	14.27	13.97	14.41	13.37	14.45	14.44	14.77	14.09	15.54	....	14.75	14.49	14.78	14.30	14.93	14.32	14.71
Cottonseed meal.....	9.26	9.73	9.02	9.42	9.26	9.65	9.35	9.60	9.17	9.91	9.73	9.42	...	10.00	9.57	9.15	9.52	10.09	9.45	10.16
Corn fodder.....	9.15	9.54	8.70	8.93	9.47	9.90	8.32	9.10	9.77	10.57	8.87	9.52	....	11.00	8.72	9.08	9.60	11.63	9.17	9.35

From Table No. IX, we see that in the majority of cases the results agree pretty closely by drying in the different vessels, but the average results are slightly higher with the crucibles. In some cases the results are decidedly in favor of the crucible, as moisture escapes in about two hours that will require five or six hours to escape from watch glasses. This is noticeable in the case of wheat flour.

In general, the amount of loss increases as the temperature and the length of time for which the heating is carried on is increased; though there are a few exceptions.

In table X are given the results of a comparison of drying in different mediums for different lengths of time and at different temperatures. From an examination of this table we must decide that the figures do not justify the conclusion of there being any special and universal advantage of one medium over another. In nearly all cases the loss is increased with an increase of temperature and time of heating, and the impracticability of getting a constant weight is made prominent.

TABLE XI.

Fat Content of Substance after Drying at Different Temperatures. In a Current of Dry and Heated Air.

	100°				105°				110°				120°				Fat in Air-Dry Substance.
	Moisture.	Fat.	Loss of Fat.	True Moisture.	Moisture.	Fat.	Loss of Fat.	True Moisture.	Moisture.	Fat.	Loss of Fat.	True Moisture.	Moisture.	Fat.	Loss of Fat.	True Fat.	
2 Hours.																	
Wheat flour.....	13.06	1.01	0.10	12.96	13.47	0.90	0.21	13.26	13.53	1.01	0.10	13.43	13.85	1.01	0.10	13.75	1.11
Cotton seed meal.....	8.05	11.71	0.16	7.89	8.16	11.48	0.37	9.79	8.83	11.55	0.30	8.53	8.80	11.69	0.16	8.64	11.85
Corn fodder.....	7.88	3.60	0.00	7.88	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.60
6 Hours.																	
Wheat flour.....	14.17	1.02	0.09	14.08	13.98	0.84	0.27	13.71	13.99	0.81	0.30	13.69	14.41	0.57	0.54	13.87	...
Cotton seed meal.....	8.92	11.76	0.09	8.83	9.01	11.41	0.44	8.67	8.94	11.68	0.17	8.77	9.57	11.52	0.33	9.24	...
Corn fodder.....	8.35	3.20	0.40	7.95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...
10 Hours.																	
Wheat flour.....	14.45	0.80	0.31	14.14	13.97	0.77	0.34	13.63	14.44	0.57	0.54	13.90	14.30	0.53	0.58	13.72	...
Cotton seed meal.....	9.26	11.74	0.11	9.15	9.26	11.35	0.50	8.76	9.17	11.52	0.33	8.84	9.52	11.52	0.33	9.19	...
Corn fodder.....	9.15	3.65	0.05*	?	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...

*Gain

The only results up to this time that we have ready for public record in connection with the fifth point under consideration are given in Table XI. This work covers the effect of drying on the fat content. It is true that the fat is not a true index to all that takes place, and must be verified by other determinations and examinations, yet it is an important factor. The results in connection with the corn fodder at the higher temperatures are withheld at present in order to make further determinations to verify a few points which are indicated by the work already done.

The fat content of the samples in their air-dry condition was as follows: wheat flour 1.11 per cent.; cotton seed meal, 11.85 per cent.; corn fodder, 3.60 per cent.

An examination of Table XI, shows that there is considerable loss of volatile fats, when high temperatures and long periods of heating are employed. Coarse fodder seems to be the more susceptible to loss from this source. There can be no doubt that temperatures above 100° C., and heating for a longer time than six hours, are to be used with great caution.

HARRY J. PATTERSON.

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and Apparatus for the same.*

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REPORT OF THE AGRICULTURIST.

BY ALBERT I. HAYWARD, B. S.

I. SILOS AND ENSILAGE.

The silo built at the College during the summer of 1888, was briefly referred to in the First Annual Report of this Station, page 54, and the method of filling the same recorded at page 74, in the same Report. To make the present record complete, some repetition is admissible.

The Silo. The silo is a simply constructed "lean-to," on the north side of the College cattle-sheds, thirty-eight feet long and thirteen feet wide. Its average height above ground is from seven to eight feet, and it is excavated to an equal depth. There are two partitions. This gives three compartments or pits, each twelve feet square inside and about fifteen feet deep. The westerly slope of the cattle-shed roof is extended to cover all. The sides of the underground part have eight-inch retaining walls of brick. All the rest of the structure is of common, rough lumber, except the interior lining of the pits; this is of narrow matched ceiling pine lumber, dressed and put on vertically, from top to bottom. Every piece of this lining was thoroughly coated with creosote oil before being put in place. The lining covers the interior faces of the brick walls, so that the ensilage may be in contact with wood, a non-conductor of heat, instead of brick. Uniformity of temperature and fermentation in the mass of ensilage is thus conserved. (An improvement would have been to make this lining of cypress lumber.) The sills on the brick walls, just above the surface, are of 2" x 8" plank, laid flat and spiked together. Two-inch plank, six inches wide, are set two feet apart for studding, and spiked securely to the sills and held at the top by a plate of same material. A sheathing of inch stuff, straight-edged and laid horizontally, close-fitting, is nailed to the studding on both sides ;

on the inside, the face of this sheathing is "flush" with the inner face of the brick wall. The sheathing is covered both inside and outside with tarred building paper; on the inside this is put on vertically and hangs to the bottom of the brick walls; on the outside, the paper is put on horizontally from bottom to top, and well lapped. The lining boards are then put on inside, as already described. On the outside boards are put on vertically, extending from roof to ground, covering the sills. On the side next to the cattle-shed, the outside of latter was covered with sheathing and then that side lined like the rest. The roof is light, cheap rafters, a single course of sheathing, and a roofing-paper cover. In the roof, over the middle pit, is a large dormer window, extending to the eaves. As the partition walls rise only to the height of the west plate, this window lights all the pits, and through it, with a carrier attached to a cutter outside, all three of the pits can be readily filled. From each pit there is an opening into the cattle-shed, arranged from the sill to plate of shed, like an ice-house door, to be removed in sections from top to bottom. These openings are fitted with triple boarding and paper between, so as to make them as nearly air-tight as possible when closed, from the time the pits are filled, until opened for feeding. These doors open directly upon the passage in front of the line of cattle-stalls, and in this passage is a car on a tramway; the ensilage can be pitched from the silo directly into the car and by the latter carried to the feeding box of every animal in the sheds. There is no floor at the bottom of the pits, simply earth; drainage is provided, as for a cellar, with provisions for preventing air and rats from entering the pits through the drain.

The three divisions or pits have a storage capacity of a little more than thirty tons each of well-packed ensilage or over ninety tons in all. The total cost of the silo was \$245, or about \$2.63 per ton of capacity. This cost might have been reduced at least one hundred dollars by omitting the brick walls of the pits and using a cheaper

grade of lumber. As built, however, the silo is substantial and will last for years. The experience of two seasons in filling and one in emptying has proved the structure quite satisfactory for its special purpose.

This silo, although easily built and comparatively inexpensive, fulfils the essential requirements for a suitable pit for storing ensilage. First, it conforms to the existing local conditions; in this case it is an addition or attachment to a set of cheap cattle-sheds, rather than an independent structure. Next, it is conveniently arranged, easily filled and emptied. And it has the needed strength to sustain all lateral pressure: it is air-tight, frost-proof and sufficiently drained.

Ensilage, 1888. The silo was first filled in the autumn of 1888, beginning on the 22d of September. The crops used for ensilage and their maturity, were as follows: A strong-growing, heavy foliated semi-dent white corn, common to the vicinity, the kernels glazed—sorghum, with seed in the dough, the varieties being Chinese and Early Orange cane—and the Soja bean, pods formed but seeds not fully developed.

Pit No. 1, was about half filled with corn and soja bean, in alternate loads, making layers of each three or four inches thick, after settling. For the upper half, sorghum was added, the three materials in alternate layers. All this forage was cut into half-inch lengths by a "Lion" feed-cutter, operated with carrier, by a portable steam engine, hired for the purpose. The material in this pit was well leveled and trodden while filling, and settled very little. On September 28th, the pit was re-filled and then carefully covered with building paper and one thickness of inch boards; this cover was weighted with brick, about forty pounds to the square foot. The ensilage was at first 13 feet in depth and settled about 18 inches. This silo was opened December 29th. The material on top was decayed on one side of the pit to a depth of six or eight inches, but through the middle and on the opposite side it was spoiled only two or three

inches deep, in some parts less than two inches. The total contents was estimated at forty pounds to the cubic foot, to be something over 33 tons, and the loss on this was a trifle more than two per centum. This may be considered a minimum of loss, and is believed to follow good material stored without interruption, with careful packing, and immediately covered and weighted. This ensilage was first offered to a herd of cows and heifers which had never eaten it before. But one of the twenty refused it the first day and after becoming accustomed to it, all the animals preferred it to good hay. While feeding from this pit, the three materials (corn, sorghum and beans) were well mixed in the silo some hours before being used, and during this interval a gentle heating was started in the heap. It was then fed while warm and seemed to be well appreciated by the cattle, on cold winter mornings. To the general herd, one feed per day of twenty to thirty pounds of ensilage was given, varied with the size of the animals, and two daily feeds of dry coarse forage and grain. The stock improved in condition and in quantity of milk produced, from the time the ensilage feeding began. Two heifers in calf and some breeding ewes, were fed for weeks absolutely nothing but the ensilage thus described, which proved this mixture to be a "maintenance ration" or "complete food," and very economical. The record of these feeding trials will be soon published in a Station Bulletin.

Pit No. 2, was filled the last days of September and first of October, 1888, with corn and sorghum alternating and cut as in No. 1. This mixture half filled the silo, and it was left uncovered and unweighted until October 25th; it had then settled about two feet, and the top was decayed to an average depth of three inches. The decayed portion was taken off, the pit filled with sorghum alone, which had been strongly frost-bitten, cut like the rest, and the decayed material was put back again for a cover. No other cover was put on, and no weight. This pit was left undisturbed till April 13th, 1889. The top

had then badly decayed to an average depth of fifteen inches, there being spots where one had to go some inches deeper to find good ensilage. The loss was heavy, but cannot be charged wholly to want of cover, for this top material was poor stuff, sorghum-fodder that had been thoroughly frosted and had apparently little value when pitted. Three-fourths of it proved edible and was relished by the stock. All the lower half of the contents of this pit was in sound condition when reached. The sorghum made good ensilage. This pit of ensilage was used to supplement pasturage during the summer months. The pastures were so good during the season of 1889, that at times very little ensilage was fed, so that the exposed and undisturbed surface in the pit molded, causing more or less loss nearly every week.

Pit No. 3 was filled on the 4th of October, 1888, with crops all of which had been frost-bitten during the two nights next preceding. Corn was mainly used, and a little sorghum. All was cut until within four feet of the top of the pit, when an accident to the power in use, stopped the cutting. The remaining space was filled with corn fodder, put in whole and well packed. A board cover was put on at this time, but no weight. On October 30th, the ensilage in this pit had settled about three feet. The decayed portion on top was removed, and a layer of new material added, one foot and a half in depth; over one-half the surface, soja beans were put in and cut corn fodder over the other half. All this was frosted forage. The whole was covered with boards, no paper, and weighted about thirty pounds to the surface foot. This pit was not opened till September, 1889. The ensilage was found more decayed than the contents of either of the others, and injured by rats burrowing in it and admitting the air. Nearly all of the late October addition was worthless. The soja beans had not moisture enough to pack well and to start fermentation, and were found harsh, dry, musty, and wholly unfit for food. Below, the ensilage was good, and although darker in

color, and with a very different smell from that stored before being frosted, it was eaten by stock without waste and with evident relish. The best ensilage in this pit was the corn put in whole, with cut stuff both above and below it. This ensilage was used in September and October, 1889, and as the pit had not been emptied when the time came to fill again, a part of the crop of 1888 still remains in the bottom of this silo.

The materials grown for ensilage in 1888, were, owing to unavoidable circumstances, so scattered about the farm, some at considerable distance from the silo, that they could not be harvested and stored with proper economy. Accordingly, no attempt was made to closely compute the cost of storing, for this season.

The chemical composition of most of the materials used for ensilage in 1888, in their different stages, and of some of the ensilage resulting therefrom, sampled when ready for use, is given in the table on opposite page.

Ensilage, 1889. The main crop grown for ensilage in 1889 was corn. The land used was the field immediately West of the silo; this had been cultivated in potatoes and sweet corn the previous season, and in the late autumn of 1888, was sown thinly with kale. It was hoped to have a good green crop to plow in, but the kale grew slowly, was much picked off by poultry and birds, while small, and only a few scattered plants were growing in the spring. During the winter and spring, the land received a liberal dressing of stable manure, hauled out and spread every few days. The field was plowed the first week in June and planted on the 7th, in rows 3 feet 6 inches apart, with seed enough for plants 5 or 6 inches apart in the row. The seed mainly used was the Virginia-grown white ensilage corn known as the "B. and W." To compare with other varieties, a test was made as follows:

Variety Test. Across the middle of the field, on very uniform land, the strip being two hundred feet long, eight

ANALYSES OF CROPS AND ENSILAGE, 1888 AND 1889.

BY H. J. PATTERSON, *Chemist.*

No. of Sample.	SAMPLE, DESCRIPTION AND DATE.	Water in Sample as taken.	COMPOSITION OF THE WATER-FREE SUBSTANCE.					
			Ash.	Protein.	Crude Fibre.	Nit'n free Extract.	Fat.	Albuminoid Nitrogen.
15	Corn grown for ensilage, Sept. 22, 1888	78.75	5.68	5.03	35.88	47.80	5.61	0.72
30	Corn, frost-bitten Oct. 4, 1888	86.00	5.54	7.42	27.02	54.75	5.27	0.98
29	Corn, frosted repeatedly, Oct. 29, 1888	77.53	5.26	5.31	31.76	54.55	3.12	0.59
20	Sweet-corn, frosted Oct. 4, 1888	76.99	5.48	6.89	26.41	56.56	4.66	0.83
00	Sorghum, Early Amber, grown for fodder (Jenkins)	82.45	4.22	6.67	33.85	53.04	2.22	....
18	Sorghum, Chinese Cane, frosted Oct. 25, 1888	78.38	6.18	6.97	31.52	50.53	4.80	0.89
19	Sorghum, Orange Cane, frosted Oct. 25, 1888	83.15	4.27	7.94	32.52	50.84	4.43	0.98
100	Rye for Fodder, in head May 28, 1889	70.89	5.27	7.17	39.99	44.49	3.08	0.86
14	Soja Bean, before blooming, Sept. 3, 1888	81.16	12.42	15.31	37.67	30.76	3.84	1.59
21	Soja Bean, as harvested Sept. 22, 1888	80.09	11.55	11.91	30.85	41.87	3.82	1.49
24	Soja Bean, on poorer soil, Sept. 26, 1888	77.47	11.14	12.33	24.69	47.75	4.09	1.61
22	Soja Bean, frost-bitten, poorer soil, Oct. 25, 1888 ..	62.29	6.92	12.35	33.20	44.47	3.16	1.19
47	Ensilage of Corn No. 15, Jan'y 29, 1889	74.90	5.17	8.16	31.16	51.03	4.48	1.00
380	Ensilage, frosted corn, No. 30 above, Aug. 14, 1889 ..	80.47	10.45	6.21	32.82	46.88	3.64	0.81
84	Ensilage of Sorghum, like No. 00 above, Apr. 22, '89.	80.25	4.33	7.88	35.06	45.90	6.83	1.14
378	Ensilage of Sorghum No. 84, bottom pit, Aug. 14, 1889.	89.49	7.73	6.74	39.38	44.22	1.93	0.90
523	Ensilage, frosted Sorghum, like No. 18, Dec. 30, 1889.	76.39	5.34	9.81	31.52	48.94	4.39	1.11
48	Ensilage of Soja Bean, No. No. 21 above, Jan. 29, '89.	72.10	9.55	11.03	27.52	48.92	2.98	1.18
379	Ensilage of frosted S. Bean, No. 22 above, Aug. 14, '89.	56.96	9.54	13.28	29.75	41.67	5.76	2.11

rows each were planted of Naylor's Prolific, Mosby's Prolific (both from the U. S. Dept. of Agriculture,) "B. and W.," and the latter repeated, with sorghum seed (Early Amber Cane) strewn thinly in the rows. The four plots were carried through the season, under almost identical conditions, and cut for the silo on the 16th of September, the ears on all being fully formed and kernels in the milky stage. (This was rather immature, but the crop was late, and danger from frost imminent. See Bulletin No. 3, of this Station, on Fodder Corn, December, 1887.)

Computed to produce per acre, the comparative crops resulted:

Naylor's Prolific Corn.....	15 tons 10 cwt.
Mosby's Prolific.....	15 " 4 "
B. & W. Ensilage Corn.....	14 " 18 "
B. & W. Corn and Sorghum....	21 " 4 "

The average for the entire field was between 15 and 16 tons per acre. This is regarded a light crop, little more than half a really good crop, and is accounted for by lack of sunshine and heat and insufficient cultivation, both incident to the exceptionally wet season. Naylor's Prolific Corn, a white dent-flint, with large kernel, was markedly in advance of the others all the time, and appears to be especially adapted to ensilage in this vicinity. The result of adding sorghum in the corn rows, is well worthy of note; the increased yield per acre of forage was 42 per cent. or nearly one half.

Note by the Director.—This result agrees with a trial made by me at Houghton Farm (Orange County, New York) in the season of 1883.

	Per Acre.
Early Amber, alone, produced.....	20 tons 5 cwt.
Ordinary Southern White corn, produced.	21 " 0 "
Special Ensilage corn (Va. grown) produced.....	27 " 10 "
The latter, mixed with the Amber-cane produced	29 " 15 "

In this case the gain was only 8 per cent, but the crop was a heavy one, averaging over 27 tons per acre, and the increase of $2\frac{1}{4}$ tons per acre by the use of the sorghum seed was quite profitable.

H. E. A.

Economy in the storage and use of ensilage depends largely upon favorable conditions on the farm where this system is practiced, such as nearness of the crop as grown, to the silo, to save hauling—capacity of the power and cutter, if the forage is cut when pitted—other facilities for handling and the condition of the crop in the field at time of harvesting. If the corn is broken, badly bent and tangled in the field, the labor is much increased. With the exception of the last difficulty mentioned, resulting from a recent heavy storm, the conditions for harvesting and storing the ensilage crop in 1889, above described, were fairly favorable. The corn was grown close to the silo and the labor and cost of hauling reduced to a minimum. Two carts easily kept the cutter supplied with all the material it could handle. This cutter, however, had not a capacity equal to the portable-thresher-engine, hired for the power.

Cost of Storing. An accurate record was kept of the cost of harvesting and storing 45 tons, put into the silo in three days, beginning the 16th of September. The force employed was as follows: Portable engine, power cutter, one 2-mule cart, one single cart, one mule hauling fuel and water for engine, (making 4 mules); 1 foreman, 1 engineer and fireman, 2 drivers, 3 corn cutters, 2 men at cutting machine, 1 man packing in silo, 1 boy helper on water cart. The items of cost were these: hire of engine and engineer 3 days, at \$4 per day, \$12.00; fuel, \$3.00; teams and manual labor, in all \$46.40; putting cover and weights on silo, \$3.00; total, \$64.40, or \$1.43 per ton. It was estimated that the tangled condition of the corn in the field fully doubled the labor of cutting and loading it, and had the feed-cutter been larger, the same engine and fuel could have doubled the

quantity cut per day, although another cart would have been needed in hauling. It is easy to see how these improvements might have reduced the cost of storing per ton to about one dollar. The season for growing and cultivating the crop, was so exceptional, and the crop itself so small, that no computation was made as to cost of production to time of harvest. These figures, if recorded, would not apply to an average season. But it may be roughly stated that the cost of making the crop, exclusive of harvesting, need never exceed \$1 per ton, if 15 tons or more per acre be produced, and can be rapidly reduced in rate per ton, with increase of crop. The Station ensilage of 1889 certainly did not cost \$2.50 per ton, when in the silo, ready for use, and next year it is expected to reduce the whole cost below two dollars per ton. This has often been done.

Note by the Director. The above record of cost of storing ensilage at the Maryland Station, in 1889, may be compared with the following record made at Houghton Farm, in 1883, in connection with the crop mentioned in the note on page 102. The main difference in conditions was a much better crop and a larger cutter at Houghton Farm, both favorable points, and greater distance for hauling and horse power, both unfavorable.

September 4th, stored in 10 hours, 30 tons, 15 cwt. Force employed, 2-horse tread power; large Belle City cutter; 5 horses and single carts; 2 mules on the power (making 7 animals); 1 foreman, 1 driver and brakeman at power; 5 cart drivers; 3 corn cutters, 2 men at feed-cutter, 2 men in silo, 1 boy to help load, and 1 boy as general helper. Cost of men and horses, per day, \$32.00, and for power, cutter and carts, \$12.00; total, \$44.00, or \$1.47 per ton. In this case, the known cost of production of ensilage corn (27 tons per acre) to time of harvesting, was 56 cents per ton, making the total cost of the ensilage ready for use, \$2.03 per ton. A careful feeding trial, with a dairy herd, in connection with this crop, proved every 3 tons of the ensilage fed to save

almost 1 ton of hay, so the crop really had a feeding value equal to over 8 tons of hay per acre. *H. E. A.*

In addition to the foregoing, Pit No. 3, filled in 1888 with frozen material, as recorded, and not entirely emptied, was refilled on the 29th of October, 1889, with soja beans and sorghum, both of which had been severely frosted. The foliage of the sorghum, which was on top and put in uncut, was so dry and harsh, that water, by the barrel, was poured on before the silo was covered, to help start fermentation. This pit was opened the 16th day of December, after being closed but 48 days. The ensilage had decayed to a depth of 14 inches and the heat of fermentation had not wholly abated. After removing the spoiled layer, the sorghum ensilage below was found pretty hard, not as succulent as most ensilage, but sound, of a dark, reddish-brown color, with a sweet taste and a strong molasses or sugar-house odor. It is relished by cattle, but is rather hard to get out, and there is some waste of the drier stalks in feeding.

For purposes of weighting, in 1889, heavy sticks of oak cord-wood were used and found convenient and effective. The experience of this Station is in favor of weighting moderately, as with brick in 1888, and fire-wood the next year, both at the rate of 30 to 50 pounds to the surface foot.

II. THE FORAGE GARDEN.

Tests of Grasses, Clovers and Forage Plants.

Very few species of cultivated grasses are in common use in the farming of Maryland. It is believed that there are other grasses which might be profitably introduced, and also forage plants, which are now almost unknown in the State. The "Forage Garden," of about an acre, was laid out on the Station grounds in the Spring of 1889, for the purpose of testing all grasses and other forage plants that will grow here, and endeavoring to find some which can be positively recommended for general introduction, or for use in special cases.

The question of mixed grasses is also to be studied at the Station, with a view to finding those best adapted to sowing together in this State, either to make a good mowing, with grasses maturing at about the same time, or a close-sodded permanent pasture, with a succession of grasses, furnishing continuous feed throughout the growing season. To begin this study of the social character of grasses, an area of one-tenth of an acre, near the Forage Garden, was carefully prepared and sown, in the Spring of 1889, with a mixture of twelve of the most promising grasses and four varieties of clover. The original intention was to sow equal numbers of seed of each species or variety used, distributed as evenly as possible on the given area, but the condition of the seed and impracticability of determining accurately the number of seeds to a fixed weight, necessitated the substitution of equal weights of the different kinds of seed. They were thoroughly mixed in two lots and sown as mixtures. The growth will be noted, and periodical examinations made to ascertain which grasses predominate at different seasons, which increase, which are simply strong enough to hold their own, and which are the weaker and become gradually crowded out of the field.

For the comparative tests of grasses and clovers grown separately and the study of their characteristics, a series of plots was laid out along the south side of the forage garden. Each plot is 50 feet long and 4 feet wide, giving room for 4 rows, 10 inches apart, and leaving spaces of 18 inches between the plots. The land had been summer-fallowed in 1888, and was carefully cleaned and raked smooth by hand. It also received a dressing of ashes, and 200 lbs. per acre of a high-grade "complete" fertilizer. The rows were marked off with a piece of matched flooring, run back and forth on edge, the "tongue" making shallow and very narrow furrows in the soil; in these furrows the seed was carefully dropped by hand. The past season, the rows of young grass plants have been kept well cultivated by hand labor. During the second season, such as have a tillering habit will be allowed to

spreach and form a more or less compact sod, three feet wide and fifty feet long. Great difficulty was experienced in getting reliable seed to start these tests. The only safe plan is to procure hand-picked, selected seed, but not enough of this could be procured. Although using every possible precaution, not a single plot of the thirty-seven sown at this Station the past season, proved absolutely pure. Where different species of the same genus were mingled, it was impossible to weed out the intruders until blossoms appeared, and of course only a part of them came into bloom the first year.

A list of the grasses, clovers and other forage plants sown and grown at this Station in 1889 is printed in Bulletin No. 5 (June), page 66. Following are brief descriptions of these plants, arranged alphabetically, according to their botanical names, with notes on the condition of the respective plots, taken during the summer and autumn of their first year's growth:—

a. Grasses.

Agrostis canina. R. I. Bent. A small low grass growing 6 to 12 inches high, not valuable as a hay grass, but affording good pasturage in many parts of our country, especially in mountainous districts. It sends out long root stalks called stolons, which put up stems at nearly every joint, making a fine dense sod.

Agrostis vulgaris. Red Top. One of the most perfect plots in the garden. This grass grows naturally in many fields and seems particularly well adapted to Maryland. Is valuable either as a hay or pasture grass, the long stolons making a firm, unbroken sod. In pastures it should be fed close, as cattle do not seem to relish it if allowed to go to seed. It grows 2 to 3 feet high, ripens about a week later than timothy and makes a finer hay. Sown with timothy, it makes a large quantity of hay of good quality.

Agrostis stolonifera. Fiorin. A variety hardly distinguishable from the true Red Top. Habit of growth and character same as last.

Aira caespitosa. *Hassock*. A worthless grass where any other cultivated grass will thrive; found in low, wet places growing in bunches. This plot a failure, land too dry even in this wet season.

Aira flexuosa. *Wood Hair*. Grows on dry hillsides, eaten by sheep, but of no agricultural value. Plot a failure.

Alopecurus agrestis. *Slender Fox-tail*. This grass is distinguished from meadow fox-tail by being an annual, and having a larger and more slender head; it grows a foot or more in height and ripens in September. It has no particularly desirable qualities, and is not cultivated to any extent in this country. Plot fair, but many open spaces.

Alopecurus pratensis. *Meadow Fox-tail*. Resembles timothy, but the head is softer and not as long. Grows 2 to 3 feet high, is best adapted to rich, moist land. Makes an excellent pasture grass, though taking two or three years to get a good stand. It starts early in the spring, ripening in May or June. This grass should be included in mixtures for pasture seeding, but is too early to be sown with timothy for hay. Plot in grass garden is in medium condition.

Ammophila arenaria. *Beach Grass*. Failed to germinate. A grass much used to protect ocean beaches from washing. It is used to some extent as a hay grass, but it has no marked agricultural value.

Antioxanthum odoratum. *Sweet Vernal*. Germinated and grew very well, making one of the best plots in the garden. It is a very early grass much liked by stock. When rubbed between the hands it gives off a peculiar, sweet, agreeable odor. It is not a very valuable hay grass, because of the small yield. It grows only a foot or 15 inches high under good conditions, and the stems are scattering and scantily leaved. Being a very early grass it sheds its seed before other grasses are cut. On account of its earliness, and its late fall growth and the fragrance or flavor which is supposed to be imparted to

the meat or dairy products of animals feeding upon it, this grass should be included in seed mixtures intended for pastures. It is abundant and thrives on most of the pastures and roadsides of Eastern Maryland.

Anthoxanthum odoratum; var. *puelli*. *Annual Sweet Vernal*. An annual grass having the same odoriferous quality as the preceding, grows in small, compact tufts and is inferior to the former as a forage plant. Station plot, good.

Avena Elatior. *Tall Oat*. This grass seems well adapted to the South. It grows 4 to 6 feet high on rich upland. It is an early grass and makes good pasturage, especially as a winter feeder. It is known in Virginia as evergreen grass. Prof. Phares says: "It is probably the best winter grass that could be obtained; it will make twice as much hay as timothy and is better adapted to the use of the Southern farmer, while it exhausts the surface soil less and may be grazed indefinitely, except after mowing." The plot made a good growth.

Avena flavescens. *Yellow Oat*. This grass has not been extensively cultivated in this country, but where tried, it seems to succeed best in a pasture mixture. In England it produces permanent pastures of great value. On the trial plot it was found to be badly mixed with Slender Fox-tail.

Cynodon dactylon. *Bermuda Grass*. A very valuable pasture grass for the extreme South. The stems root at every joint, making it hard to eradicate where once it gets a hold, thus making a serious pest in cultivated fields. But it is eaten readily by cattle, and when cautiously handled, it is much prized as pasturage. It rarely matures seed in this country, but may be propagated by cutting the roots into short pieces with a hay cutter and scattering them over the ground and lightly cultivating or rolling them in. This grass formed the most dense, compact sod in the garden.

Cynosurus Cristatus. *Crested Dog's-tail*. A small, low grass, not cultivated to any extent in this country. Station plot in fair condition.

Dactylis glomerata. Orchard Grass. The most widely diffused of all the grasses, adapting itself to a great variety of circumstances, is said to be grown successfully in every part of this country. It is a very early and also a very late growing grass, ripens in May or early June, can be cut on good soil two, and sometimes three times per season, grows from 3 to 4 feet high, and yields a good quality as well as large quantity of hay. It should be cut before it is ripe, as the stems become hard if left too long. It is too early to sow with timothy, but about right to sow with red clover. If sown alone, it should be seeded very thick so that it will cover the ground; otherwise it will grow in bunches. Plot very fine.

Festuca duriuscula. Hard Fescue. Grows from 1 to 2 feet high, is a good pasture grass, but is not much cultivated. Our plot is poor.

Festuca elatior. Tall Fescue. Grows from 2 to 3 feet high, is the largest and coarsest of the fescues, but stock will eat it readily. It is a very nutritious grass, thriving well in the South. It should be sown with other grasses to get the best results. Plot good.

Festuca heterophylla. Various-Leaved Fescue. A variety of fescue with narrow basal leaves and wide spreading leaves on the upright stems; has no qualities which will recommend it above the tall fescue. Seed in plot failed to germinate.

Festuca ovina. Sheep's Fescue. A good pasture grass for sheep; grows on dry, sandy soils where other and better grasses fail. Cattle do not eat it readily. Plot fine.

Festuca pratensis. Meadow Fescue. "The Randall grass of Virginia." Grows 2 to 3 feet high, ripens early in June, is good for pasture as well as for hay, succeeds well in Southern States. Probably the most valuable of the fescues. Some writers seem to suppose *Festuca pratensis* and *Festuca elatior* identical. Dr. Geo. Vasey mentions them as distinct, *Festuca elatior* being larger and coarser. Our Station plot is good. In another part

of the experiment grounds an area of several square rods has been seeded to Meadow Fescue alone, and is very promising.

Festuca rubra. Red Fescue. A large variety of fescue with a reddish tinge on its broad leaves. A good grass but not much cultivated in this country. The seed on our plot failed to germinate.

Festuca tenuifolia. Slender Fescue. A small fescue having no particular merit over the preceding varieties of this grass: grows on thin, light soils. The Station plot is poor.

Holcus lanatus. Meadow Soft Grass. A grass growing 1 to 2 feet high, covered with fine, soft hair, giving it a velvety appearance very distinct from other grasses. It is not much relished by cattle. Often does well on dry lands where other grasses fail to grow, and has been used on such lands as a green manure, with good results. Where the better classes of grass will grow, this should not be introduced. It is quite common on the roadsides of this State. Plot doing well.

Lawn Grass. A mixture sent out by the U. S. Department of Agriculture, of a number of grasses especially for lawns. Plot germinated finely, and formed a dense green mat well suited to its purpose.

Lolium Italicum. Italian Rye Grass. A rapid growing grass, but must have rich land and liberal feeding to get the best results. When so treated it is one of the very best hay or soiling grasses, its rapid growth allowing of several cuttings in favorable seasons. It is the largest and most valuable of the rye grasses. Our plot very fine.

Lolium perenne. English Rye. Smaller than the preceding. It is wider distributed in this country and better known; is a good hay and pasture grass, relished by all kinds of stock. Plot very good.

Phleum pratense. Timothy. The most common of our cultivated grasses and one of the best. On rich soil it attains a height of 5 and even 6 feet. To obtain the

largest yields of hay it should be sown with other grasses, like redtop, which matures at about the same time. The bulbous roots will not withstand severe drouth or too close grazing, and for this reason it is not recommended as a pasture grass, or as a hay grass for the extreme south. Plot very good.

Poa arachinifera. Texas Blue. Said to be a good grass in Texas, but not cultivated in the east. The seed has a peculiar linty substance adhering to it which makes it impossible to sow broadcast as it clings together in small masses.

Poa aquatica. Water Meadow. Valuable only for low, wet places. Seed failed to germinate.

Poa compressa. Canada Blue. A small grass growing on dry, hard pastures, too small to be valuable for hay, but where it grows well it is one of the most persistent and nutritious of pasture grasses. It differs from Kentucky blue by having a flat, compressed stem and smaller flower head. The seed is seldom found in the market. Plot in medium condition.

Poa memorialis. Wood Meadow. A grass well suited to shady pastures but where other grasses thrive, more suitable ones for pasture can be selected. Seed failed to germinate.

Poa pratensis. Kentucky Blue or June Grass. One of the best *Poa* grasses for pasture. It is known by some name in almost every State. It is principally valued as a pasture grass, affords early feed, is much sought by stock, and should be included in every pasture mixture. Plot in medium condition. •

Poa serotina. Fowl Meadow. A very valuable hay grass common in New England and the north generally. Grown in moist meadows and swamps from 2 to 3 feet high. If allowed to stand after ripening, each joint sends up a branch which makes the bulk of the crop green and succulent while other grasses in a corresponding state would be dry and hard, and this grass is expected to prove valuable for use in this State. The plot is in fair condition.

Poa trivialis. *Rough-stalked Meadow.* A good pasture grass, adapted to low, wet meadows, and along shady streams. Not extensively cultivated. Plot fair.

Sorghum halapense. *Johnson Grass.* Grows from 4 to 6 feet high; stems when ripe coarse and woody. Until within a few years, regarded as a weed in the Southern States because of the difficulty in eradicating it when once well established in the soil, and the little regard taken of its feeding value. Lately it has been used as a hay grass with good success and is coming into general favor among southern farmers. It should be cut before becoming ripe, to prevent the stems from getting hard, and will yield two or three crops per season. Probably most valuable for States south of Maryland where the best grasses cannot be grown successfully. Our Station plot very luxuriant and fully matured.

Sporobolus airoides. *Bunch Grass.* A western grass and probably worthless in Maryland. Seed on trial, plot failed to germinate.

b. Clovers.

Trifolium hybridum. *Alsike or Swedish.* This clover was supposed by *Linnaeus* to be a cross between the common white clover and the red clover. The name "Alsike" comes from a Swedish village where it is extensively cultivated. It partakes of the character of both white and red. The flower heads are shaped like the white and pink in color. It is smaller than red clover, has finer leaves and stems, grows upright though not as tall, and roots do not penetrate the soil as deep. It is more nearly perennial, and it is claimed that "clover sickness of land" has not yet appeared on fields sown with this plant. On the contrary it is recommended to be sown on clover-sick lands. A rich, moist soil, either clay or heavy loam, will produce good alsike. It is a better pasture plant than red clover, standing feeding better, but apparently not as much relished by cattle. The trial plot is in good condition.

Bee or Honey Clover. A further trial is necessary as very few of the seeds germinated. The plot this year was a failure.

Lotus corniculata. Bird's Foot Clover. A plant of slender growth the branches creeping along the ground or gradually ascending, attaining a height of from 6 inches to 2 feet. Cultivated as a forage crop in Germany and England but new to this country. In those countries is considered valuable as an addition to pastures. Plot poor, very few seeds germinating.

Melilotus alba. Bokhara Clover. A plant now growing wild in some sections of this country. It has not been cultivated, to develop its feeding value. The plot is fair, 12 or 15 inches high with branching tree-like stems; more extended trials will be given it.

Lespedeza striata. Japan Clover. Prof. Phares of Mississippi, says of this plant: "Stock do not relish it at first, but tasting it a few times they become very fond of it for grazing and hay. In many places they abandon the natural pastures in March, April or May and confine themselves to this until frost kills it down. By frequent grazing or mowing it is kept in a growing, tender, palatable and digestible condition. Cattle fatten on it and produce superior milk, butter and beef." The seed on the plot germinated well and soon spread over the ground, forming a very dense mat 6 or 7 inches in height. Growth continued until frost killed it. In southern states it attains a height of a foot or more. It is doubtful if seed in a sufficiently developed condition to germinate was produced here, though some blossoms were observed. Being an annual, it will be necessary to reseed every spring if these few seeds fail to grow. The above statement in regard to its feeding value will hold true in Maryland but it has not grown large enough here this past season to cut for hay.

Medicago sativa. Lucerne or Alfalfa. A perennial plant, growing 3 feet high or more, very largely cultivated in California and some western states and success-

fully grown in the South, though not in such large areas. Some of the experiments with it in the east and north have been successful but failure has generally been the result, unless the soil is warm and rich and kept carefully freed from weeds, until it has become fully established. Lucerne thrives best in irrigated land though it is capable of withstanding severe drouths, its long tap-root being often 8 or 10 feet, penetrating the subsoil and obtaining moisture where plants with shorter roots would perish. Lucerne is best adapted for soiling and may be cut three or four times in a season, yielding a large amount of forage which is liked by all kinds of stock. Our trial plot germinated well and grew 6 or 8 inches high when it became diseased. The leaves turned yellow and growth stopped. Whether it will develop better next season or not, remains to be seen.

Trifolium incarnatum. Italian or Crimson Clover. An annual clover, on good soils making a large growth. The flower head is long, more cylindrical than round, like red clover, and of a bright crimson color. On account of its annual habit it is not as valuable as red clover, either for pasture or permanent meadow. Seed germinated well and the first of the season the clover looked very fine. About midsummer the petioles or leaf-stems began to rot off, the leaves dropping to the ground; this condition continued for about two months. In September growth again began and on the first of December it was the greenest and most healthy looking of the plots of clovers. There were very few flowers this season, and present appearances indicate that it will survive the winter and probably flower next season.

Trifolium pratense. Medium Red Clover. Every farmer knows something of the value of red clover. It grows on almost any soil that is not too wet. Its long tap-root reaches down into the subsoil for fertility that is beyond the reach of surface rooted plants, like wheat and many of the grasses, and it brings the fertility to the surface. When plowed in as a green manure, as it often

is, it returns this plant food to the soil in a position where the succeeding crops may lay hold of it. It not only contains the mineral elements derived from the soil but a large amount of nitrogen which is the dearest plant food that we have to buy in commercial fertilizers, and this is also returned to the soil. Whether it is able to take this nitrogen directly from the air, or indirectly, is not fully settled. Other plants of this family possess these same characteristics but none are so widely diffused and so successfully grown as red clover. As a hay crop it is very valuable, yielding large quantities of very excellent forage. Care should be taken in curing, that it may not get too dry, so that leaves and blossoms break off in handling. It has been satisfactorily used as an ensilage crop. All kinds of stock eat this clover greedily, either dry or green. It makes an excellent addition to a seed mixture either for meadow or pasture. It should, however, if for hay, be sown with early kinds like orchard grass. The plot is in good condition, germinated well.

Trifolium pratense. Giant Red or Sapling Clover. Very similar to the last, but grows larger and coarser. Plot equally good.

Trifolium repens. White Clover. Not a valuable hay plant except where it is used as a bottom grass, in which case it often increases the yield considerably. As a pasture grass it is very much liked by stock; it bears feeding well and grows on poorer soils than red clover. It is a favorite honey-producing plant, and as such it is often cultivated in quite extensive areas. Plot medium.

Trifolium filiforme. Yellow Clover. Has no practical value over the other clovers. Where it grows naturally it makes a good pasture, but too low and spreading for hay. Plot poor.

c. *Forage Plants.*

Of the other plants tested in the Forage Garden, Esparsette, Giant Spurry, Lupine, Small Pea, Serradella

and Sulla failed to germinate or at most only two or three plants grew, so that a fair comparison was not obtainable. Some of these plants are being used with such good results in other countries that it seems desirable to give them a further trial. The remainder are reported upon as follows:

Hairy Vetch. A plant with long, trailing stems having tendrils which aid it in climbing. If sown alone it is unable to maintain an upright growth, which makes it difficult to harvest. To facilitate growth and gathering, it might be sown and harvested with some strong growing plant, like oats. The plot germinated and grew well, but there was very little forage when it had matured. It has this season shown no qualities as a forage plant which specially commend it.

Hungarian Grass. Many farmers are mistaken in supposing this to be identical with *millet*. It does not grow as tall, has a very much smaller head, of a darker color and generally yields considerably less per acre. It will grow on poorer soil, but the richer the land the better the crop. Hungarian grass makes excellent hay or it may be used as a soiling crop with good results. It should be sown in May or early June, late sowing not proving successful here. Trial plot good; over two feet high.

Pearl Millet. A plant resembling corn in its growth but maturing its seed on a spike, often a foot long by $1\frac{1}{2}$ inches in diameter. It suckers freely, 6 or 8 stalks often maturing seed from the same root. It grows to about the same height as corn, but the stalks are not as large and would probably be eaten up cleaner by cattle. The seed germinated well and a good yield was obtained, equal to a good crop of sorghum.

Teosinte. The plants as grown here resembled corn just before tasseling, the leaves were long and numerous. There were no tassels or other indications of maturing seed. It attained a height of six feet, but did not sucker here, although in warmer sections it is remarkable for this habit, often throwing up fifty and sometimes as many

as eighty shoots, from one root. It is very highly recommended by Prof. Phares as a forage plant for the South, but it will not compare with common corn in yield, in this section. The plot was almost perfect, and considered a fair test for the plant in this region.

Kaffir Corn. Resembles dwarf sorghum, growing 4 to 6 feet high, stalks small and yield corresponding. Where corn or sorghum can be grown as in Maryland it is not worth while to attempt the growth of Kaffir corn. Two varieties were grown, the red and the white. The former was a few inches taller but otherwise they were alike. The plot was good, probably fairly representing the capabilities of the plant in this State.

Soja Bean. Three acres of soja bean were grown in 1888 and about the same area this season, both crops being used for ensilage. The most perfect growth was about three feet high, stems somewhat branched but not spreading; leaves numerous, forming a large bulk of the plant. If too rank a growth is made, the stems become hard and woody, but this may be remedied by making ensilage of it. The greatest yield per acre yet obtained with this plant was the crop of 1888, the best plot being at the rate of five and one-fourth tons of green forage. The Forage Garden plot made a good, even growth, and matured its seed, which has not been done by field crops at the Station.

Unknown Pea. By accident this forage plant was not included in the garden plots. However, an area of a quarter acre was planted to test the productiveness as depending on the amount of seed used. The land was divided into plots of one-eighth acre each, and check-rowed, the rows being three feet three inches apart: Plot I was planted with three pease per hill, using ten and three-fourths ounces of seed, at which rate it would take 5.37 pounds or one-eleventh of a bushel, per acre. Plot II received six pease per hill, or just double the quantity allowed plot I, per hill and per acre. Plot I, where the smaller amount of seed was used, yielded 992 pounds or at the rate of 7,936 pounds of green forage

per acre. Plot II, with twice the seed, yielded 960 pounds or 7,680 pounds per acre, giving a difference of 256 pounds per acre in favor of light seeding. This possible economy in the use of seed is a valuable characteristic of this variety of Southern cow pea.

Millo Maize. Resembles Goose-neck Sorghum very much. Stalks from 6 to 10 feet high, with compact head bending over and hanging down. Plot good.

Non-saccharine Sorghum. Five varieties of non-saccharine sorghum were planted. All gave a heavy growth of good forage; no one was so superior as to deserve special mention.

d. *General Grass Seeding.*

In addition to the above plot work, tests have been begun of the following mixtures of grasses and clovers sown on an old pasture. The adaptability of the plant to our pastures, its power to maintain itself, its qualities as a grazing plant and the preferences of stock, are to be observed. Areas of about half an acre were used except in the case of Japan clover, where nearly three acres were sown. (1) Meadow Fescue, Orchard Grass and Kentucky Blue. (2) Kentucky Blue, Red, White and Crimson clovers. (3) Meadow Fescue, Alsike, White and Crimson clovers. (4) Alsike, Red, White and Crimson clovers. (5) Crimson clover, Alsike clover, White clover and Red clover separately. These plots were sown in March, on unbroken though nearly bare pastures, where the soil was light and moist; a heavy roller was used after sowing to pack the soil and press the seed into it. All caught well and the season was favorable to a good growth. The Japan clover fully substantiated the claim made for it by Prof. Phares and quoted above. The other clovers were good but probably did not make their greatest growth this season. The same is true of the grasses.

Over twenty acres have been seeded to grass with wheat during the past year. In order to be able to

(Text continues on page 122.)

TABLE No. II.

VARIETY TEST OF OATS.

Plot number	NAME OF VARIETY.	Date headed out.		Date of harvest.	Length of Straw and Head.		Length of Head.	Production Grain per Acre.	Production Straw per Acre.	Weight of a Meas-ured Bushel.		Source of the Seed used.
		Mo. Day.	Mo. Day.		Ft. In.	Inches.				Lbs.	Lbs. Oz.	
1.	Clydesdale	6—17	7—7	7—7	4—4	9	33.5	3228	31—5	J. & S.		
2.	Clydesdale	6—17	7—7	7—7	.....	.....	35.3	3172	33—13	Hend.
3.	Clydesdale	6—17	7—8	7—8	.....	.....	34.5	3144	30—9	R. & L.
4.	Hargetts' Seizure	6—19	7—8	7—8	4—5½	9½	30.	3137	29—10	Agl. Dept.		
5.	Hargetts' Seizure	6—19	7—8	7—8	4—3	9½	32.8	3247	30—0	Har.		
6.	Scottish White	6—19	7—8	7—8	3—11½	7½	35.	3181	30—9	Til.		
7.	Impr. Scotch Potatoe.	6—17	7—8	7—8	4—2	8½	32.6	2256	25—3	Buist.		
8.	Scottish Chief	6—17	7—8	7—8	3—8½	6½	27.4	2872	28—2	Ever.		
9.	Gold Yel. French	6—22	7—16	7—16	3—10	9½	26.8	2237	21—12	Vaug.		
10.	American Banner	6—20	7—11	7—11	3—9½	7½	26.	2169	23—4	Vaug.		
11.	White Wonder	6—17	7—8	7—8	3—6½	7	32.4	2312	31—6	Salz.		
12.	Curry's Prize	6—17	7—8	7—8	4—4½	9½	31.9	2378	30—5	Currie.		
13.	Ex. Dakota White	6—19	7—11	7—11	4—2	8½	27.	2334	23—15	Salz.		
14.	White Bonanza	6—17	7—8	7—8	3—11½	8½	30.	2143	30—6	Salz.		

15.. New Japan.....	6—20	7—8	4—1	8½	30.4	2128	32—4	R. & L.
16.. New Centennial.....	6—20	7—8	4—1	8½	28.6	2384	30—12	Wils.
17.. Welcome.....	6—20	7—8	4—4	8½	29.8	2253	31—6	Md. Ag. Coll.
18.. Bodger Queen.....	6—17	7—7	3—11	8½	31.6	2287	32—8	Vaug.
19.. Wide Awake.....	6—20	7—11	3—8½	8½	25.8	2237	23—4	R. & L.
20.. Wide Awake.....	6—12	7—8	3—8½	7	35.8	1803	23—14	J. & S.
21.. Egyptian.....	6—22	7—11	4—0	8	28.1	2800	30—2	Vaug.
22.. Canada Black.....	6—24	7—16	4—0	9½	30.2	3534	26—6	Vaug.
23.. Black Tartarian.....	6—24	7—16	3—7½	8½	34.8	2584	23—6	Hend.
24.. Black Russian.....	6—12	7—8	3—2	6½	33.	1750	31—4	Leon.
25.. Red Rust Proof.....	6—12	7—11	3—3½	5½	34.	2018	26—7	Wils.
26.. Texas Rust Proof.....	6—12	7—8	3—8½	7½	34.	2312	25—14	
27.. Pringles' Progress.....	6—12	7—11	3—1½	8½	39.	2450	23—6	J. & S.
28.. Surprise.....	6—20	7—11	4—1	8½	33.	3547	23—4	J. & S.
29.. White Belgian.....	6—20	7—11	4—3½	9½	31.6	2840	29—14	J. & S.
30.. Improved American.....	6—19	7—11	4—3½	8½	34.4	2550	23—4	Ag. Dept.
31.. Harris.....	6—19	7—11	4—7½	9½	28.	2512	29—10	H. F.
32.. Unknown.....	6—12	7—11	3—2	6	51.	2568	25—	Md. Ag. Ex. Sta.
33.. American Beauty.....	7—8	7—24	3—6½	7	11.6	1775	20—4	Alex.
34.. Challenge.....	7—8	7—24	3—1	8½	9.	1209	19—6	Alex.
35.. Black Tartarian.....	7—8	7—24	.....	.....	7.9	3150	19—8	Jer.
36.. Maud S.....	7—8	7—24	4—3	9½	.....	.....	.....	Buck.

The facts presented by the table require little comment. It is apparent that the straw was good, and the grain product light. The two largest yields are Nos. 32 and 27, respectively, 51 bushels and 39 bushels, standard weight. Both of these gave light grain, so the actual measurement was a good deal more. No. 32 was a peculiar oat, very erect, with a short straw, and with several attractive features; unfortunately, its identity, and the source from which the seed was obtained, has been lost. An effort will be made to discover this, and it will be grown again at this Station on a larger area. The heaviest oat obtained was from Henderson's Clydesdale. This, and several others, will be given further trial. The abbreviations used to designate the seedsmen, in the last column of the table, will be found explained on a page near the end of this pamphlet.

compare the grasses and for other reasons, each kind was sown by itself. About six acres of timothy were sown in the fall of 1888 with the wheat. The rest were sown broadcast in March, 1889, on the growing wheat, viz: 4 acres of Orchard grass, 2 acres of Meadow fescue, 2 acres of Redtop, 2 acres of Medium Red clover, 3 acres of Sapling clover and 3 acres of Alsike clover.

III. VARIETY TEST OF OATS.

This test included 33 varieties. The growth of straw, character and quantity of grain, ability to resist rust and other diseases and adaptibility to climate, were the qualities especially observed. The land for this test had been cropped with soja beans in 1888, without fertilizer, and was in a low state of fertility and cultivation. It was fairly uniform in quality as shown by the record of the bean crop, harvested in small plots. The land was plowed and harrowed the 26th of March, 1889; being then rather wet, it was allowed to remain two days before sowing. A fertilizer consisting of a mixture of dissolved bone and muriate of potash was drilled in with the seed, at the rate of 350 pounds per acre. The seed was sown with a "Superior Drill," at the rate of 3 bushels per acre. Each variety occupied one drill-width on plots 200 feet long, arranged side by side. All were sown the 28th day of March, except plots 33, 34, 35 and 36, the seed for which was not received till May.

At harvest the plots were trimmed down at the ends to just one fiftieth of an acre.

The season was favorable on the whole, although rather too wet, and all made a heavy growth. No rust was observed. This fact may be attributed to the season and not to the varieties used in the test. There was a blight, common to all, which without careful examination might be overlooked. This was seen in the heads and individual grains; although apparently perfect, these were often nothing but husks, no kernel being found

inside. This was best seen at the time of fanning, when these false grains, being so much lighter than the well-filled, were blown over onto the sheet. As before stated, this was common to all, but it was very much more marked in the few varieties sown in May.

The time of heading out is given in Table No. II. as the relative earliness of the variety, but as a check the time of ripening or harvesting is also given. The oats were cut when the grain had passed the doughy state by one or two days.

To obtain the average length of straw and head, ten stalks of average height were measured and the average of these was assumed to be the height of the variety. The yield is computed at 32 pounds per bushel; otherwise the figures would be misleading as in many cases, if the results were calculated in measured bushels, the yields given would have been too great. While no very large yields were obtained, the plots were considered very uniform and giving a fair average crop for the season. The four varieties of seed received late and sown the 4th of May are exceptions to this statement. A very small quantity of seed was obtained from these and in the case of the "Maud S." variety, not enough to record the weights.

IV. VARIETY TEST OF WHEATS.

A variety test of wheat was made with 40 different varieties, sown late in 1888. The wet weather prevented putting these plots in earlier. Some of the varieties were badly winter killed, and the continued wet weather of the Spring made it impossible to obtain a fair record of comparative yields of varieties. The plots were carefully harvested, however, and sample sheaves, single plants and threshed grain were obtained, sufficient to make an interesting comparative exhibit at the Autumn shows of 1889. Pure seed was also secured for a second trial, which now promises to give better results. The plots sown in 1889, are one-fortieth of an acre, or one

drill-width (9 hoes,) and 200 feet long, with spaces of 14 inches between varieties.

Aside from plot-work, a field of 23 acres was sown in 1888, with three varieties of wheat which produced as follows: Deitz, $8\frac{1}{2}$ acres, yield, 14.4 bushels per acre; Fulcaster, 8 acres, yield, 13 bushels per acre; Fultz, 7 acres, yield, 11 bushels per acre. The Deitz, or Longberry, which did the best, was from seed raised on the College farm, while the seed for the other two, was selected from the choicest lots which could be found in other counties. The wretchedly low product is accounted for by poor land, the crop being put in more for the cultivation, and to cover grass and clover, than for the wheat, and by the failure to fill or mature grains, the heads being very light or "scab-by," according to the local descriptive name.

A soil test with fertilizers, using wheat as the crop, has been undertaken for 1890. Plots of one-tenth of an acre will be treated with different fertilizing materials, and the effect of the continued use of the same fertilizer on the plots will be observed, with wheat and other crops, in rotation.

V. VARIETY TEST OF CORN.

Plots were laid off between the young trees in the apple orchard, for this test. Each variety occupied a square, and was separated from the next plot by a space of 12 feet, it being thought objectionable to have corn growing within six feet of the trees, either way. The field was check-rowed, the rows 3 feet, 4 inches apart.

The excessive rainfall of the early spring rendered planting very late, and continued wet weather greatly injured the entire crop, so that in growth and product no varieties were equal to their normal standard. A complete list of varieties planted is given in Table No. III. on the next page.

(Text continues on page 126.)

TABLE No. III.
VARIETIES OF CORN GROWN FOR COMPARISON.

NAME.	SOURCE OF SEED.	NAME.	SOURCE OF SEED.
<i>Pops.</i>			
Red Rice.....	Vaug.	Mosby's Prolific, W..	Agl. Dept.
Striped Rice.....	"	Naylor's Prolific, W.....	"
Queen's Golden	"	North Star, Y.....	Vaug.
California Golden.....	"	Parrish, W.....	Agl. Dept.
Mapledale	"	Piasa Queen, Y.....	"
Ill. Snowball.....	"	Piasa King, W.....	Vaug.
White Rice.....	"	Pride of the North, Y.....	Scharff.
Prem. Pearl.....	"	Scharff's Harford County, Y....	Sil.
Wis'n 8-rowed.....	Suf.	Scott's Improved, W.....	Vaug.
Suffern's Monach.....	"	Silver's Yellow.....	Suf.
<i>Dents.</i>			
Calico	Vaug.	Simpson's Yellow.....	Agl. Dept.
Chest. Co. Mammoth, Y.....	"	Suffern's Cham. Pearl, W.....	"
Cranberry.....	"	White Giant Normandy.....	Vaug.
De Cellums, W.....	Agl. Dept.	Wisconsin White.....	"
Eastern Shore, W.....	"	Woodworth's Yellow.....	Alex.
Edmons, Y.....	Vaug.	<i>Flints.</i>	
Golden Beauty.....	Harg.	American Prolific.....	Vaug.
Hickory King, W.....	Vaug.	King Phillip.....	"
June Planting, W.....	Agl. Dept.	Longfellow	Md. Ag. Ex. Sta.
Leaming, Y.....	Vaug.	Primitive.....	Vaug.
Minn. King, Y.....	N. Br. & G. Co.	Vermont Pedigree.....	Alex.
Mixed, W. and Y.....	Md. Ag. Ex. Sta.	Wisconsin White.....	Vaug.

[W. = White.]

Y. = Yellow.]

The flint varieties, so prolific and hardy at the north, were a failure here. The stalks grew less than six feet high and often without an ear on them. The varieties of pop corn making the best yield were, Red Rice, Queen's Golden, Premium Pearl and Mapledale. All of this class, however, did pretty well. The yellow dent varieties which seem deserving of special mention, are Golden Beauty, Leaming, Chester Co. Mammoth and Silver's Yellow. Of the white dent varieties, Piasa King, De Celums and Parrish; the Cranberry also gave a good yield.

The product, in general, was so poor and so uneven, that no attempt was made to obtain comparative records of yield per acre, or details respecting the character and quality of plant and grain. These points are left for a trial in some better corn season.

VI. SOIL TESTS WITH FERTILIZERS AND CORN.

The most practical and satisfactory analysis that can be made of a soil is by growing common farm plants, with and without manures. Soil tests made by dividing a certain area of uniform land into small plots and using different fertilizing materials on these, are much more valuable to the farmer than any chemical analysis can be. If the soil is rich and contains a sufficient quantity of the different elements of plant food in an available form, for the growth of the crop, no marked effects will be seen from the addition of a single fertilizing element. But on lands that have been cropped for a series of years, especially if the same crops have been grown year after year, the probabilities are that a one-sided exhaustion has taken place and that the addition of the right element of plant-food will return a good crop. If by a little careful work on a small area, a farmer can determine what his field of 20, 30 or 50 acres most needs, it may save him from buying a complete fertilizer and thereby spending money for plant-food that is already in the soil in sufficient quantity.

The land used at this Station, for this soil test, was nearly level and apparently a uniform piece of ground. It was divided into plots one rod wide by ten rods long, making one-sixteenth of an acre. The 22 plots arranged side by side were subdivided across their length, making sections of one-thirty-second of an acre. One series, or half of the sections, was planted with the variety, Piasa Queen, a yellow dent sent out by the U. S. Department of Agriculture. The other, with Scott's Improved, a fine white dent variety from the Eastern Shore of Maryland. These two varieties of corn had the same kind and amount of fertilizers on different sections of the same plot. Section II of Plots 1, 2, 3, 4 and 5 were of a different quality of soil and were not included in the test. The plots were check-rowed, 3 feet 4 inches apart, giving four rows to a plot and leaving a space of six feet between outside rows of contiguous plots.

The fertilizer was spread broadcast and harrowed in; the quantity applied was governed by its composition, and relation to an adopted standard. For example: Nitrate of soda was used at the rate of 160 pounds per acre on plot 2. Plot 3, received dried blood, of which enough was used so that the same amount of *nitrogen* was applied per plot as would be used in applying 160 pounds nitrate of soda per acre. Bone black at the rate of 320 pounds per acre was used as a standard for phosphoric acid fertilizer, and muriate of potash, 160 pounds per acre for potash.

The corn was planted May 30th. Germination and growth were uniformly good considering the season and very little difference could be observed between the plots. The wet weather caused late planting and imperfect cultivation and sufficiently accounts for a generally poor crop. Plot 5 gave the best yield, with dried fish, being 39 bushels of shelled corn per acre. By comparing in the table, the yields of section I, plots 2, 3, 4 and 5, with that of section I, plot 7, which had the same amount of

(Text continues on page 130.)

TABLE No. IV.
SOIL TESTS WITH FERTILIZERS AND CORN.
Calculates Yield per Acre.

Plot Nnumber.	FERTILIZER.	Amt. Fert. per Acre. lbs.	SECTION I.			SECTION II.		
			Var.:-	Piasa	Queen.	Var.:-	Scott's	Improved.
			Stalks lbs.	Total Corn.	Per Cent. Soft.	Stalks lbs.	Total Corn.	Per Cent. Soft.
1	Nothing..	....	2752	1760	9	.....	.....	.....
2	Nitrate of Soda.....	160	3200	2304	12	.....	.....	.....
3	Dried Blood.....	211.2	3104	2672	6	.....	.....	.....
4	Castor Pomace.....	470.4	3296	2288	17	.....	.....	.....
5	Dried Fish.....	323.2	3200	2720	11	.....	.....	.....
6	{ Dis'd Bone Black Dried Blood	{ 320 211.2 }	2720	2080	23	2700	1706	11
7	{ Dried Blood..... Dis'd Bone Black..... Muriate Potash	{ 211.2 320 160 }	3072	2144	26	3360	1568	12
8	Dis'd Bone Black.....	320	2400	1376	16	2432	1280	15

9	Key Stone Phosphate.....	121.6	2624	1440	13	1920	512	25
10	Orchilla Guano.....	209.6	2016	1120	20	2304	1088	11
11	Nothing.....	....	3040	1216	16	2272	1248	13
12	Mona Id. Guano.....	192	2112	1120	8	2336	1184	13
13	Thomas Slag.....	184	1984	1312	5	2368	1632	6
14	Cotton Seed Hull Ash.....	376	2432	1504	10	2656	1216	2
15	{ Muriate Potash}..... { Dried Blood}.....	160 211.2	2656	1568	10	3136	1504	4
16	Muriate Potash.....	160	2368	1344	5	2784	1664	4
17	Sulphate Potash.....	160	2432	1344	7	2784	1568	4
18	Marl.....	6400	2080	1152	16	1952	1472	6
19	Lime.....	1600	2144	1824	10	2560	2272	7
20	Land Plaster.....	296	1728	1056	15	2656	1984	8
21	Nothing.....	.....	2016	1312	10	2272	1952	8
22	Nothing.....	.....	1984	1216	16	1888	960	20

nitrogen, and in addition, the phosphoric acid and potash (a "complete fertilizer") we see that the nitrogen alone gave as much as the combined elements of plant food, or that just as good a crop of corn could be grown on this soil by the application of 160 pounds per acre nitrate of soda or 211 pounds of dried blood, alone, as by adding the 320 pounds of bone black and 160 pounds muriate potash. It is evident from the yields of the "nothing" plots, put in for comparison, that the soil was already in pretty good condition for a crop. Other deductions might be made from the table on pages 128 and 129, but the conditions were so unfavorable that it is proposed to make a repetition of the test, in the hopes of getting more decided results.

VII. THE ROTATION PLOTS.

The six rotation plots laid out in 1888 and cropped with corn, as reported in the First Annual Report of this Station, were subdivided crosswise into four sections each. At the proper time for corn to be planted on the plot, section I, will have a dressing of commercial fertilizer. Section II will have an equal amount of plant food in the form of stable manure, and also at the time of bringing wheat into the rotation, it will have a dressing of commercial fertilizer. Section III will have the same amount of stable manure as section II, but without commercial fertilizer. Section IV will have no fertilizing material except in the green sod turned in the rotation. Thus, on the six rotation plots, the effects will be observed of rotation without fertilizer, with stable manure, with stable manure, supplemented by commercial fertilizer and with commercial fertilizer alone.

The records will include the treatment of the plots manures applied, general observations on the growth of the crops and the yields in detail. Of course the records are as yet very meagre, and it will be some years before results of any value can be obtained.

Plot 1.

Sown to grass. Orchard grass, alsike and red clover.
No crop yet taken off.

Plot 2.

Sown to grass. Orchard grass, alsike and red clover.

Plot 3.

Sown with rye in 1888, and grass seed applied in Spring of 1889. No fertilizing application. Crop of 1889, rye (instead of wheat) and very poor. Yield of straw and grain :

Sect. I.	Sect. II.	Sect. III.	Sect. IV.
108 lbs.	82 lbs.	40 lbs.	98 lbs.

Plot 4.

Sown to Crimson clover in the Spring; this was plowed under in October, and wheat was sown. No crop removed.

Plot 5.

Sown with oats April 15, 1889, and seeded with clover at same time. No fertilizing material applied. Harvested July 17th.

Yield :—Sect. I.	Sect. II.	Sect. III.	Sect. IV.
Grain, lbs., 47	52	58	66
Straw, lbs., 105	98	136	235

Plot 6.

A small crop of green rye was turned under about equal to a grass sod. Planted in May with Harford county corn, a large yellow dent variety. Fertilized as follows :

Sect. I, 50 lbs. Dissolved Bone Black, 142 lbs. D. Blood, 41 lbs. Muriate Potash.

Sect. II, 3,408 lbs., stable manure.

Sect. III, 3,408 lbs., stable manure.

Sect. IV, nothing.

Yield :—Sect. I.	Sect. II.	Sect. III.	Sect. IV.
Grain, lbs., 264½	280½	269	177
Top fodder, lbs., 84	102	106	74
Blades, lbs., 28	30	42	14
Butts, lbs., 217½	296½	369	202½

Remarks: The corn plot of this year, No. 6, is the only one worthy of any comment. Although the crop was very poor, a total rate of $28\frac{1}{3}$ bushels of shelled corn per acre, the effects of manuring are apparent on both grain and fodder product, and while commercial fertilizers did about as well as stable manure for grain production, the latter caused a decided gain in growth of stalks.

VIII. "SEED-GERMINATOR" TESTS.

A small tin can of unknown material was received at this Station in April, 1889, from F. P. Dimpfel, of New York City, "Sole Agent for the United States and Canada," who represented the powder as a "New Preserver and Germinator of Cereals and Seeds of all Kinds," and requested that it be tested. The circular stated that "it is an ammoniac substance, containing in solution metallic salts, anti-parasitic in their effects. It not only acts for the destruction of insects and the combatting of parasitic corpuscles, but it also takes the place of manure;" also that "it is now fully recognized in France as the salvation of the agricultural interest." Printed directions for its use as a "seed germinator" were found inside the box. Accordingly, 300 seeds each of Soja bean, Unknown pea and Breck's ensilage corn, were treated as per directions in the package. For comparison, an equal number of seeds taken from the same lots, were soaked in pure water for twenty-four hours before planting and a third set, otherwise equal, was planted dry. All were planted at the same time, side by side, on a small garden plot. Following are the results:

Soaked in solution of "Germinator."	Soaked in water.	Planted dry
Beans, germinated, 77 per ct.	72 per ct.	80 per ct.
Peas, " 3 per ct.	78 per ct.	87 per ct.
Corn, " 63 per ct.	58 per ct.	67 per ct.

Those planted dry were a very little longer in making their appearance, but were fully as large as the others three days later, and produced the best plants for two months afterwards. The "treated" lots gave the poorest results throughout the trial.

REPORT OF THE MECHANICAL DEPARTMENT.

By E. H. BRINKLEY.

General Duties. To superintend and watch over all steam, water, gas and heat apparatus and supplies and to keep the same in proper condition. To repair all farm machinery, to give trial to all new machinery, to take and record all weights, and in summer to perform any special work which may be assigned. During the past summer, as special work, this Station grew ten acres of sorghum for the Agricultural Department in Washington, to assist in making a very exhaustive test as to varieties, selection of seed, and the effects of different manures or fertilizers upon the growth and quality of the cane; this sorghum field was under the supervision of the machinist, by special assignment.

Boiler and Coal. The boiler used is of twelve horsepower, and it heats the entire building and supplies steam to the laboratory for drying-ovens, distilled water apparatus, &c.

The amount of coal used during the last full year was $39\frac{1}{2}$ tons. The fires were kept burning nearly as much during the summer as in colder weather, on account of the large amount of steam needed in the work which was being done in the laboratory.

Pump and Pumping. A compound, double-acting, bucket-plunger pump is used, which can be converted into an engine by a single adjustment. We thus have a good 4 horse-power engine to run any light machine that is desired. The water which is used here, is pumped from a well located 40 feet south of the pump, and is forced through a $1\frac{1}{4}$ inch pipe to an elevation of 152 feet above the base of pump, where two large tanks are located, one of iron, the other of wood, in the attic of the College building. These have a capacity of over 6,000 gallons, and from them the following buildings are supplied: the College proper, laboratory at the College,

President's house, Experiment Station, and laboratory at same; they also furnish water for four steam boilers. The Station gas machine is also operated by water, instead of weights, as commonly used for this purpose. The Station does the pumping for the use of the tank and pipe, which furnish at all times, at the Station, a stream of $1\frac{1}{4}$ inches in diameter, with a pressure of about 80 pounds to the square inch.

During the last year there were pumped 664,256 gallons of water, and the pump was operated, more or less, 230 days during the year.

Farm Machinery. All machinery purchased, or sent to College or Station for trial, is given a fair, impartial and practical trial, and a full record made for subsequent report. The trials of the past season included one Steel Deering Binder, one Superior Grain Drill, one Rigby's Improved Potato Digger, four Parks' Transplanters, and three Seed Sowers, (one Leader, one Thomson and one Calhoun.)

Binder. The trial of the binder was satisfactory. It is a standard machine and does good work, if properly put up and operated. We cut $23\frac{1}{2}$ acres of wheat in nineteen and a half hours without trouble. Three mules were used abreast; draft was not recorded.

Drill. The drill, like the binder, is of a standard make and well known, and needs little comment. Like so many other machines of this class, the fertilizer distributor is the weakest point; in this case the castings under the fertilizer cups are frail and need strengthening. This drill has nine spring hoes, or drill tubes.

Potato-Digger. This digger is a plow, to run under the row or hills with attachments for sifting and separating earth and potatoes, leaving the latter on the surface. The ground is also left in a comparatively smooth and satisfactory condition. The trials here were made on land in fair condition for the season, but rather more moist

than desired for potato-digging. The crop was very poor and of course the implement could not show its best work without an abundance of potatoes to dig, which we did not have. The draft of this digger was found to range, in different soils, from 300 to 600 lbs., never exceeding the latter except when starting in heavy soil, or on passing a particularly compact place; then it ran up towards 700 lbs., but it did not quite reach that point at any time in the trials. The draft is just about the same as a common plow in ordinary plowing of the same soil. The draft was considerably less than that of a plow turning its first furrow of a "land." But the digger ran but little if any more than half as deep as the plow, that is, four to five inches instead of seven or eight.

Shallow work is the fault of this digger, and unfortunately it is not constructed so as to permit adjustment by clevis, etc. Even with a long chain from clevis to evener, it did not run deep enough and frequently left potatoes, grown by flat culture, below the bottom of its furrows. Sometimes its point cut through large potatoes.

In our trials, from two-thirds to four-fifths of the potatoes in the crop were left on the surface, so as to be easily picked up behind the digger. The rest were lightly covered with soil and were brought into sight by running a harrow or a cultivator after the digger.

In its present form this Rigby Potato Digger is a pretty good potato plow, but by no means a perfect implement. Some of its faults can be easily remedied, and its Maine manufacturers already announce improvements which are claimed to be certain to cause it to do much better work another season. It is fair to say that, with a heavier crop and larger tubers, it would have done better this year.

Transplanter. This machine is known as the Parks' Planter and does good work under favorable circumstances, i. e., the soil in good condition and moist, with the plant having good length of stem and shank. With

such plants as cabbages, sweet potatoes and tomatoes, it works well and saves time over hand planting. In a comparative trial which we gave it in setting cabbage, the percentage of stand and growth was as good as it was from hand planting, and the amount of labor expended was in favor of the planter.

It is true the past season has been very moist, and almost any plant would live if the roots were buried at all.

The weakest point of the machine, and as now made a very weak one, is where the blades which enter the ground are riveted to the body or base of the machine; it bends out of shape easily at this place, especially if the soil is a little hard or packed. The price of the machine, \$8.00, is too much for the material and labor it represents.

Seed Sowers: The Thomson and Cahoon sowers are both well known; they are reliable machines and will do good work. The Leader is not as well known; it distributes seed of either grains or grasses evenly, but throws heavy seeds such as wheat and rye so far, and distributes so fast, that the operator has to carry too much bulk and weight, or else must stop too often to renew his supply. The maker claims fifty feet in breadth at a single round for wheat, at $1\frac{1}{2}$ bushels per acre; this is too much according to the trial given by us, and 30 feet is nearer right, for proper seeding. Timothy seed can be spread about 20 feet. The sower itself is simple, light and easily operated.

Scales and Weighing: The platform scales are of five-ton capacity and on these all the heavy weights are taken in connection with the Station work, and all are recorded for future reference. During the past year there have been 470 weighings recorded.

EXPLANATION OF ABBREVIATIONS.

In order to economize space the names of seedsmen from whom seed was obtained are not given in full in the tabular reports, but we here give a key to the abbreviations of their names, as used in this Report.

Alex.	O. H. Alexander	Vermont.
Agr'l Dept.	U. S. Dept. Agriculture.	Washington, D. C.
Bragg.	B. L. Bragg & Co.	Springfield, Mass.
Buck.	H. W. Buckbee	Rockford, Ill.
Buist	Robert Buist	Philadelphia, Pa.
Burp.	W. Atlee Burpee & Co.	Philadelphia, Pa.
Cleve.	A. B. Cleveland & Co.	New York, N. Y.
Cowan	A. D. Cowan	New York, N. Y.
Currie.	Currie Brothers	
Ever.	J. A. Everitt	Indianapolis, Ind.
Ferry.	D. M. Ferry & Co.	Detroit, Mich.
Ford.	Frank Ford & Sons.	Ravenna, Ohio.
Greg.	J. J. H. Gregory	Marblehead, Mass.
Har.	P. L. Hargett & Co.	Frederick, Md.
Hend.	Peter Henderson & Co.	New York, N. Y.
H. F.	Houghton Farm	Mountainville, N. Y.
J. & S.	Johnson & Stokes	Philadelphia, Pa.
Jer.	Geo. W. P. Jerrard	Caribou, Me.
Land.	D. Landreth & Sons	Philadelphia, Pa.
Leon.	S. F. Leonard	Chicago, Ill.
Liv.	A. W. Livingston's Sons	Columbus, Ohio.
Maule	Wm. Henry Maule.	Philadelphia, Pa.
McCul.	J. M. McCulloughs Sons	Cincinnati, Ohio.
Mich.	Michigan Agr'l College.	Agr'l College, Mich.
N. B. & G. Co.	Northrup, Brosnan, & Goodwin Co.	Minneapolis, Minn.
Pearce.	J. S. Pearce & Co.	London, Ont.
R. & Z.	Roop & Zile	Westminster, Md.
Salz.	J. A. Salzer	La Crosse, Wis.
Scarff	Henry Scarff	Taylor P. O., Md.
Sil.	J. R. Silver	Glenville, Md.
Suf.	J. C. Suffern	Illinois.
Til.	I. F. Tillinghast	La Plume, Pa.
Thor.	J. M. Thorburn & Co.	New York, N. Y.
Vaug.	J. C. Vaughn	Chicago, Ill.
Wils.	Samuel Wilson	Mechanicsville, Pa.

METEOROLOGICAL RECORD.

COMPARATIVE TABLE OF MONTHLY TEMPERATURES, 1889.

MONTH.	PLACE.							
	COLLEGE.		BALTIMORE.		CUMBERLAND.		WASHINGTON, D. C.	
	Mean.	Normal.	Mean.	Normal.	Mean.	Normal.	Mean.	Normal.
	1889.		1889.		1889.		1889.	
January	39.3	.....	38.	.....	29.4	34.7	31.8	39.2
February	32.3	.....	29.	.....	31.0	28.0	36.5	31.1
March	45.4	.....	43.	.....	36.8	41.9	40.2	43.4
April	54.2	.....	54.	.....	48.6	52.3	52.9	54.4
May	63.6	.....	65.	.....	59.8	62.9	64.6	64.6
June	70.1	.....	71.	.....	68.5	67.2	72.6	70.8
July	74.3	.....	77.	.....	72.0	73.6	76.8	75.8
August	70.6	.....	72.	.....	69.8	69.2	74.6	72.4
September	66.2	.....	65.	.....	62.0	64.0	68.9	65.6
October	50.7	.....	54.	.....	50.8	49.5	57.8	52.5
November	45.6	.....	46.	.....	39.8	41.8	45.4	46.2
December	44.9	.....	46.	.....	31.5	43.2	35.8	45.6

COMPARATIVE TABLE OF MONTHLY RAINFALL, 1889.

MONTH.	PLACE.										
	College.		Baltimore.			Cumberland.			Washington, D. C.		
	Amount. 1889.	Rainy days.	Normal.	Amount. 1889.	Rainy days.	Normal.	Amount. 1889.	Rainy days.	Normal.	Amount. 1889.	Rainy days.
	In.	No.	In.	In.	No.	In.	In.	No.	In.	In.	No.
January	3.68	8	3.25	4.22	12	2.11	3.01	5	3.42	4.05	11
February	2.36	8	3.50	2.53	12	2.48	2.07	6	3.30	2.47	7
March	4.47	10	4.00	5.71	13	2.71	3.52	6	4.23	4.20	14
April	9.20	13	3.01	8.70	16	2.34	3.22	5	2.85	9.13	17
May	8.47	16	3.21	6.82	16	2.82	7.02	8	3.48	10.69	16
June	6.80	12	4.10	6.17	14	3.41	3.10	12	4.36	5.01	14
July	8.73	12	4.56	11.03	18	3.70	2.74	10	4.55	8.13	15
August	1.78	6	4.46	1.40	6	3.15	1.52	7	4.46	3.07	10
September	3.58	15	3.73	4.59	15	2.68	4.16	10	3.97	3.88	15
October	4.60	10	2.99	4.12	12	2.19	2.84	6	3.10	4.48	10
November	5.85	14	3.17	6.45	16	2.12	5.34	14	2.85	6.03	17
December	0.26	5	2.99	0.51	9	2.14	1.63	9	3.12	0.19	7

METEOROLOGICAL RECORDS FOR 1889.
MONTHLY SUMMARY OF MEAN TEMPERATURES.
In Degrees Fahrenheit.

MONTH.	Daily Mean.	Mean Daily Maximum.	Mean Daily Minimum.	Mean Daily Range.	Extreme Maximum. Date and Record.	Extreme Minimum. Date and Record.
January	39.3	50.17	27.85	21.66	2d.—66	23d.—15.5
February.....	32.3	39.33	21.51	17.35	5th.—53	24th.—4
March.....	45.41	56.43	35.93	23.56	13th.—67	12th.—20
April.....	54.25	65.48	44.01	17.01	3d.—78	5th.—28
May.....	63.66	73.55	51.38	25.32	9th.—96	2d.—33
June.....	70.16	80.13	58.95	22.43	17th.—90	2d.—49
July.....	74.39	84.72	65.82	19.70	10th.—96	15th.—53
August.....	70.60	82.53	61.32	23.60	31st.—94	17th.—50
September.....	66.21	78.55	56.77	21.43	6-7-15th.—89	28th.—41
October.....	50.78	64.08	41.08	22.51	12th.—86	9th.—27
November.....	45.62	55.21	36.33	19.85	1st.—74	7th.—22
December....	44.98	54.51	35.29	26.00	26th.—72.5	1st.—18
Yearly Means.....	54.80	65.38	44.68	21.70	{ May 9th.—96° { July 10th.—96°	Feb. 24th.—4°

METEOROLOGICAL RECORDS FOR 1889.

MONTHLY SUMMARY OF RAINFALL, SUNSHINE AND WIND.

1889. — MONTH.	RAINFALL.		SUNSHINE.			WIND.	
	Total precipita- tion in inches.	Number of rainy days.	Actual duration. Hours and minutes.	Total possible. Hours and minutes.	Number of days without sunshine.	Prevailing direction.	Total movement in miles.
January.....	3.68	9					
February. ...	2.36	9					
March.....	4.47	11					
April.....	9.20	13	121-19	399-13	8		
May.....	8.48	18	150-6	446-28	6		
June.....	6.80	13	187-41	448-27	8		
July.....	8.73	12	191-47	454-20	7	S. W.	2221.7
August.....	1.78	6	121-26	424-13	14	S. W.	1729.0
September...	3.58	15	104-48	373-6	14	S. W.	3940.7
October.....	4.60	10	94-0	342-59	10	W.	2635.3
November...	5.35	14	70-49	298-20	19	W.	2285.8
December....	0.26	5				W.	2305.9
	59.59	135	1041-50	3187-6	86	W. S. W.	14108.4

The numbers in the column of "rainy days" include all days on which more than one-hundredth of an inch of rainfall was measured. There were nine additional days during the year, on which rain or snow fell, but insufficient in quantity to be measured.

METEOROLOGICAL RECORDS FOR 1889.

PRECIPITATION IN INCHES. (*Rain and Snow.*)

DATE.	JANUARY.		FEBRUARY.		MARCH.		APRIL.	
	Total Precipitation.	Snow.	Total Precipitation.	Snow.	Total Precipitation.	Snow.	Total Precipitation.	Snow.
1.....			.04					
2.....							.40	
3.....							1.71	
4.....								
5.....	1.08		.08		2.25			
6.....								
7.....								
8.....								
9.....	.50				.01	.15		
10.....	.11		.10	1.00				
11.....							.02	
12.....							.08	
13.....							.30	
14.....								
15.....					.01			
16.....	.38		.94					
17.....							.36	
18.....			.52		1.42			
19.....					.25			
20.....	1.01				.32			
21.....							.51	
22.....			.15	1.50	.20			
23.....								
24.....								
25.....	.20						1.37	
26.....	.10						3.38	
27.....	.30		.49	4.50			1.01	
28.....			.04				.02	
29.....								
30.....							.04	
31.....					.01			
Totals.....	3.68		2.36	7.00	4.47	0.15	9.20	

METEOROLOGICAL RECORDS FOR 1889.

PRECIPITATION IN INCHES, (RAIN AND SNOW.)

	MAY.	JUNE.	JULY.	AUGUST.
DATE.	Total precip- itation.	Total precip- itation.	Total precip- itation.	Total precip- itation.
1.....	.32	1.59	.75	.48
2.....	.....	.....	1.04	.....
3.....	.....	.....	.01	.....
4.....	.....	.07	.50	.....
5.....	.....	.....	.....	.05
6.....	.....	.....	.....	.....
7.....	.....	.....	.....	.06
8.....	.....	.....	.....	.....
9.....	.....	.....	.....	.....
10.....	.46	.45	.....	.64
11.....	.01	.43	.06	.....
12.....	.....	.86	.....	.....
13.....	.03	.16	.55	.....
14.....	.59	.191	.....	.....
15.....	.29	.....	1.34	.....
16.....	.....	.....	.....	.....
17.....	.....	.03	.....	.....
18.....	.....	.12	.....	.....
19.....	.33	.....	.11	.....
20.....	.51	.....	.....	.....
21.....	.39	.....	.....	.....
22.....	.28	.08	.....	.01
23.....	.43	.....	.....	.54
24.....	.47	.....	.....	.....
25.....	.02	.43	.03	.....
26.....	1.16	.67	.86	.....
27.....	.85	.....	.48	.....
28.....	.....	.....	.....	.....
29.....	.....	.....	.....	.....
30.....	.59	.....	.....	.....
31.....	2.07	.....	3.00	.....
Totals.....	8.48	6.80	8.73	1.78

METEOROLOGICAL RECORDS FOR 1889.

PRECIPITATION IN INCHES. (*Rain and Snow.*)

DATE.	SEPTEMBER.	OCTOBER.	NOVEMBER.	DECEMBER.
	Total Precipitation.	Total Precipitation.	Total Precipitation.	Total Precipitation.
1.....	....	.45	....	....
2.....	....	....	.02	....
3.....	....	....	.34	....
4.....	....	....	....	....
5.....	.60	....	....	....
6.....	....	....	....	....
7.....	....	....	....	....
8.....	....	....	.17	....
9.....	....	....	1.41	....
10.....	....	....	....	.04
11.....	....	....	.19	.06
12.....	....	....	....	....
13.....	.88	....	1.50	....
14.....	.03	....	....	....
15.....	.09	1.31	....	....
16.....	.01	....	....	....
17.....	1.28	....	.02	....
18.....	.04	....	.75	.08
19.....	....	....	.34	....
20.....	.04	....	.07	....
21.....	....	.15	.38	....
22.....	....	....	.04	....
23.....	....	1.34	....	....
24.....	....	....	....	.08
25.....	.54	....	....	....
26.....	.04	.56	....	....
27.....	....	.74	.08	....
28.....	....	....	.54	....
29.....	....	.02	....	....
30.....	.03	....	....	....
31.....	....	.92	....	....
Totals.....	3.58	4.60	5.85	0.26

METEOROLOGICAL RECORDS FOR 1889.

SUNSHINE IN HOURS AND MINUTES.

DATE.	APRIL.			MAY.			JUNE.		
	Actual duration.	Possible amount.	Percentage of possible.	Actual duration.	Possible amount.	Percentage of possible.	Actual duration.	Possible amount.	Percentage of possible.
	H. M.	H. M.		H. M.	H. M.		H. M.	H. M.	
1....	.....	12-42	....	None.	13-54	.....	10-30	14-49	.71
2....	4-2	12-44	.32	5-49	13-56	.42	11-11	14-50	.75
3....	None.	12-47	.....	2-15	13-59	.16	4-8	14-51	.28
4....	"	12-49	.....	6-22	14-01	.45	7-12	14-52	.48
5....	"	12-52	.....	6-54	14-03	.49	10-15	14-53	.69
6....	"	12-55	.....	7-49	14-05	.56	12-2	14-53	.81
7....	6-37	12-57	.51	7-50	14-06	.56	10-59	14-55	.74
8....	12-1	13-00	.92	6-14	14-09	.44	4-5	14-55	.27
9....	9-49	13-02	.75	6-24	14-11	.45	8-13	14-56	.56
10....	8-0	13-06	.61	8-2	14-13	.57	9-4	14-56	.61
11....	7-47	13-09	.59	5-54	14-15	.41	10-30	14-57	.70
12....	.....	13-11	.....	6-15	14-18	.44	None.	14-57	.....
13....	1-7	13-14	.08	3-14	14-20	.23	"	14-58	.....
14....	5-54	13-15	.45	6-6	14-22	.42	5-50	14-58	.39
15....	None.	13-18	.....	6-14	14-24	.43	7-53	14-58	.55
16....	"	13-20	.....	8-0	14-26	.55	8-7	14-59	.54
17....	"	13-23	.....	8-0	14-28	.55	7-17	14-59	.49
18....	2-42	13-25	.20	7-19	14-29	.51	None.	15-00	.....
19....	7-44	13-28	.57	None.	14-31	.....	"	15-00	.....
20....	5-58	13-30	.44	"	14-33	.....	9-37	15-00	.64
21....	8-0	13-32	.59	4-27	14-35	.31	10-48	15-00	.72
22....	8-2	13-35	.59	3-24	14-36	.23	10-46	15-00	.72
23....	8-0	13-37	.59	6-53	14-37	.47	9-37	15-00	.64
24....	7-29	13-40	.57	4-29	14-38	.31	None.	15-00	.....
25....	None.	13-42	.....	None.	14-40	.....	"	15-00	.....
26....	"	13-44	.....	4-32	14-42	.31	"	14-59	.....
27....	"	13-46	.....	None.	14-43	.....	7-11	14-59	.48
28....	7-50	13-48	.57	7-39	14-44	.52	6-30	14-58	.44
29....	6-22	13-50	.46	7-55	14-45	.54	5-56	14-58	.40
30....	3-55	13-52	.28	2-6	14-47	.14	None.	14-57	.....
31....	.....	.....	.....	None.	14-48	.....	.....	.....	.....
Sums.	121-19	399-13		150-6	446-28		187-41	448-27	
Daily means	4-3			4-50			6-15		

METEOROLOGICAL RECORDS FOR 1889.

SUNSHINE IN HOURS AND MINUTES.

DATE.	JULY.			AUGUST.			SEPTEMBER.		
	Actual duration.	Possible amount.	Percentage of possible.	Actual duration.	Possible amount.	Percentage of possible.	Actual duration.	Possible amount.	Percentage of possible.
	H. M.	H. M.		H. M.	H. M.		H. M.	H. M.	
1....	None.	14-57	.....	None.	14-15	.....	8-2	13-04	.61
2....	3-11	14-54	.21	"	14-13	.....	8-0	13-01	.61
3....	1-47	14-54	.12	"	14-11	.....	None.	12-58	.....
4....	2-47	14-53	.19	"	14-09	.....	"	12-56	.....
5....	8-15	14-52	.56	"	14-07	.....	"	12-53	.....
6....	11-23	14-52	.77	"	14-05	.....	3-10	12-51	.25
7....	10-59	14-51	.74	8-0	14-03	.57	None.	12-48	.....
8....	11-5	14-51	.74	7-52	14-01	.56	"	12-45	.....
9....	10-42	14-50	.72	None.	13-39	.....	4-14	12-43	.36
10....	12-3	14-49	.81	"	13-56	.....	None.	12-41	.....
11....	None.	14-48	.....	7-1	13-54	.52	"	12-39	.....
12....	11-5	14-47	.75	9-29	13-51	.68	"	12-36	.....
13....	9-45	14-46	.68	None.	13-49	.....	"	12-33	.....
14....	10-53	14-45	.74	3-6	13-47	.22	7-1	12-31	.56
15....	6-53	14-43	.49	4-42	13-44	.34	5-7	12-28	.41
16....	10-13	14-42	.70	8-4	13-42	.59	None.	12-26	.....
17....	10-30	14-41	.72	8-0	13-39	.59	"	12-23	.....
18....	10-53	14-40	.74	7-11	13-37	.53	6-15	12-20	.51
19....	None.	14-38	.....	None.	13-35	.....	8-5	12-17	.66
20....	12-5	14-36	.70	8-0	13-32	.59	5-29	12-15	.45
21....	11-17	14-34	.77	7-10	13-30	.52	6-56	12-12	.57
22....	1-45	14-33	.12	None.	13-27	.....	8-4	12-09	.66
23....	7-5	14-31	.49	"	13-25	.....	8-0	12-06	.66
24....	5-12	14-29	.36	6-28	13-23	.48	None.	12-04	.....
25....	2-36	14-27	.18	9-0	13-20	.61	"	12-01	.....
26....	None.	14-25	.....	None.	13-19	.....	5-0	11-59	.42
27....	2-59	14-24	.21	4-5	13-16	.31	4-2	11-56	.34
28....	None.	14-22	.....	8-3	13-14	.61	9-28	11-53	.80
29....	6-24	14-20	.45	7-55	13-11	.60	7-55	11-51	.67
30....	None.	14-18	.....	None.	13-09	.....	None.	11-48	.....
31....	"	14-16	.....	7-20	13-6	.57	.....	.....	.....
Sums.	191-47	454-20		121-26	424-13		104-48	373-6	
Daily means	6-11			3-57			3-29		

METEOROLOGICAL RECORDS FOR 1889.

SUNSHINE IN HOURS AND MINUTES.

DATE.	OCTOBER.			NOVEMBER.		
	Actual Duration.	Possible Amount.	Percentage of possible.	Actual Duration.	Possible Amount.	Percentage of possible.
	H. M.	H. M.		H. M.	H. M.	
1.....	5 1	11 46	.43	None.	10 27	....
2.....	8 0	11 43	.70	"	10 25	....
3.....	7 55	11 40	.68	2 15	10 23	.22
4.....	9 24	11 38	.81	8 10	10 20	.79
5.....	8 0	11 35	.69	None.	10 18	....
6.....	None.	11 33	..	7 35	10 16	.77
7.. ..	5 10	11 30	.45	None.	10 14	....
8.....	7 50	11 27	.68	"	10 12	....
9.....	8 5	11 25	.71	"	10 9	....
10.....	8 15	11 22	.73	7 20	10 7	.72
11.....	..	11 20	.....	None.	10 5	...
12.....	....	11 17	.....	"	10 3	....
13.....	....	11 14	.....	"	10 1	....
14.....	....	11 12	.....	8 0	9 58	.80
15.....	....	11 9	.....	5 30	9 56	.55
16.....	....	11 7	.....	9 15	9 54	.93
17. ....	....	11 4	.....	None.	9 52	....
18.....	....	11 2	.....	"	9 51	....
19.....	8 10	10 59	.74	"	9 48	....
20.....	8 4	10 56	.74	"	9 47	....
21.....	2 0	10 53	.18	"	9 45	....
22.....	None.	10 51	.....	"	9 43	....
23.....	"	10 49	.....	"	9 42	....
24.....	8 6	10 47	.75	5 24	9 39	.56
25.....	None.	10 44	.....	None.	9 38	....
26.....	"	10 42	.....	6 28	9 36	.67
27.....	"	10 40	.....	None.	9 35	....
28.....	"	10 38	.....	"	9 34	....
29.....	"	10 35	.....	5 15	9 32	.55
30.....	"	10 32	.....	5 11	9 30	.55
31.....	"	10 29	.....	....	....	....
Sums	94 0	342 59	.....	70 43	298 20	....
Daily means..	...	....	.....	2 21	....	....

MISCELLANEOUS PAPERS.

BY THE DIRECTOR.

THE SORGHUM FIELD.

By a special arrangement, this Station cultivated ten acres of Sorghum for the U. S. Department of Agriculture, to assist in the general work of this class by the Chemical Division of that Department. The 10 acres were laid out 700 feet one way by 622 the other. The plots of the first 4 acres, on North side, were made 50 by 40 feet, with spaces 7 feet wide between; these were planted with seed collected from all parts of the world where sorghum grows. Seventy varieties were used, including crosses, on these four acres. This section received a heavy dressing of a complete commercial fertilizer.

Next, South of the first section and occupying the middle of the field, were two acres planted in four equal parts with standard varieties, the Early Orange, Early Amber, Link's Hybrid and Kansas Orange. On these varieties were used twenty different fertilizers and mixtures of fertilizers. The four half-acre plots ran the entire length of the field from East to West, and the fertilizers crossed these, in plots $28\frac{1}{2}$ feet wide; two of these plots received no manuring of any kind.

The four acres on the South were arranged in plots like the Northern section. This was sown in drills $3\frac{1}{2}$ feet apart, and the fertilizer belts described, crossed this section. On this portion of the field selected seed was used, most of it being from single canes grown in Kansas in 1888 and which had proved to be exceptionally high in saccharine quality.

The planting was commenced on June 18th and finished on the 24th of June. The season being so very wet, it was impossible to plant sooner. The plowing was not done till late in May.

The first seed came up on June 21st, and the first varieties to show heads, on August 24th, were, No. 34, Whitings Early; No. 245, Black Seed Bicolor; No. 96, Cross of Orange; No. 246, Red Seed Bicolor.

The first samples of cane cut and sent to the Department, went in on the 23d of September. Six lots of 15 average stalks each, were then sent every working day until Oct. 22d, when instructions were received to cease shipping, as the frost was getting too severe and the cane deteriorating in sugar.

Some weights were taken as to yield of green cane per acre, as follows:

Plot	Yield per acre.	Name.
No. 97,	25,800 lbs.	New Orange.
" 112,	20,400 "	Orange and India. .
" 100,	19,800 "	Cross of India.
" 117,	21,600 "	A Cross Bred.

All these were grown on the first section of the field. planted in hills $3\frac{1}{2}$ by 3 feet apart. Weights were taken of eight samples of 10 stalks each, with the following record:

Plot	Length of Canes	Weight	Name
147	$6\frac{1}{2}$ feet	16 lbs.	Planter's Friend.
149	$6\frac{1}{2}$ "	14 "	Planter's Friend.
164	9 "	16 "	Red Siberian.
137	8 "	14 "	Lost Name.
143	9 "	16 "	Planters's Friend
159	10 "	14 "	Bombay.
158	9 "	16 "	Bombay.

Numbers 147 and 149 were not as tall as the rest, but had much heavier foliage.

After being informed by the Department that no more was needed for chemical examination a large part of the crop, although badly frosted, was fed to cattle in pasture and the remainder was put in the silos.

The supervision of this field was especially assigned to the Machinist, Mr. Brinkley, and the records were all kept by him.

The crop, as a whole, was a poor one, on account of the season, and the record, thus made without the sugar determinations, has little interest or value, aside from showing how part of the Station labor and attention was applied during the season of 1889. The preparation and care of this 10-acre field of sorghum, involved a good deal of hard work.

H. E. A.

LOSSES IN GROWING WHEAT.

Cost of Threshing and other Items.

BY THE DIRECTOR.

More than once it has been remarked—and in other States as well as Maryland—that the State Agricultural College, with its farm, ample in area, “should make its own bread.” A similar and apparently very sensible principle has been often stated, that “every farm should produce the bread for its own people.” Without stopping to discuss whether such is the purpose and best use of a college farm, or whether the rule stated should be applied to every farm—an honest endeavor was made, beginning in the autumn of 1888, to make the College farm produce, in the year 1889, wheat enough to make the bread used at the College the same year. It was known that we needed about fifty barrels of flour, and the endeavor was to raise wheat enough in excess of the required seed, to make this quantity of flour. In this we succeeded—the Maryland Agricultural College made its farm produce bread enough for the Institution for the year 1889—but the experiences in this connection, bearing upon the economy of the proceeding, are so striking in themselves, and so applicable to many, if not all, of the wheat-growing farms of this State, that it is thought desirable to thus record some of the leading features.

There is nothing worthy of special comment as to the land, its preparation or the growing of the crop. All the usual operations were performed, and although the season was unfavorable in its later portion, the heads failed to fill and a poor crop was evident, the grain was ready for the harvest at the usual time. This work was performed with a self-binding reaper, and the sheaves well dried and brought to a good condition for early threshing without unusual detention or expense.

Threshing and its Cost. Wheat, rye and oats being ready, threshing was done July 27, 1889. A "separator and cleaner," accompanied by a portable steam engine, was hired in the neighborhood, being regarded as an efficient equipment for the work in the hands of capable and honest men. Three men came with the machine, the owner, who acted as overseer of the work, an engineer and fireman, and a feeder for the thresher. Two men and six animals had to be sent to bring the machines to the farm, occupying a half day, and soft coal had to be provided for fuel. (Half of these items are later charged to the wheat.) The machinery, its owner and helpers, were to be paid at the usual prices for threshed grain, 4 cents per bushel for wheat and 8 cents per bushel for rye, and 3 cents for oats. Extra help had to be employed, and all being in readiness the day before, the force engaged in the actual work of threshing, July 27th, besides the men accompanying the machine, was as follows:

Three pairs of horses and mules hauling sheaves from field to machine, one animal drawing away straw, one animal hauling water and fuel to engine, one man cutting bands, one helper at table, two men measuring and sacking, two moving straw and chaff, two stacking straw, five with hauling teams and one with the water cart, a total of fourteen (14) men and eight (8) animals, as the home force. The work accomplished for the day, according to the measurement tally, was 304 bushels of wheat, 28 bushels of rye and 224 bushels of oats. (Threshing this grain actually required rather more than one day of the force stated, but detentions in hauling, caused by distance of part of grain from the threshing yard, and lack of hauling wagons, makes it fair to place all as one day's work, as it might have been, had circumstances been more favorable.)

The items of cost were as follows :

Hauling machinery to the farm.....	\$ 4 00	
Soft coal and hauling the same.....	1 50	
Labor of 14 men, 1 day each.....	14 00	
Board of 10 extra men, 1 day each.....	4 00	
Labor of 8 animals, 1 day each.....	8 00	
		<hr/>
		\$31 50
Paid for threshing—304 bus. wheat at 4c..	12 16	
28 bus. rye at 8c...	2 24	
224 bus. oats at 3c...	6 72	
		<hr/>
		21 12
		<hr/>
Total for this day's work.....		\$52 62

We wish, however, to deal particularly with the cost of threshing wheat, and while it may not be exactly accurate, it is fair to charge a full half of the general expenses to the wheat, and what was actually paid to the machine and its men for the wheat threshed. These sums would be \$15.75 and \$12.16, making \$27.91 as the total cost of getting out 304 bushels of wheat, threshers measure. This is a trifle over 9 cents per bushel, which, for the season named was about eleven per cent, of the market value of the grain, a cost altogether disproportionate to this part of the labor of producing and marketing wheat. If there is any error in this computation, the figures are too low, for some of the men employed cost more than a dollar a day, and that rate for working animals at that season, is low. It may be claimed that wages of men stacking straw should not be included in cost of threshing; but this is generally considered a part of the work, and stacking near by is about as easy a method as any to get the straw away from the machine.

But this was not all. As so generally happens, the machine, although an average of its kind, failed to clean the grain properly and it was all over-measured. It was necessary to handle all the wheat and oats again, running

them through a hand fanning mill, and the shrinkage was found to be unexpectedly large.

The 304 bushels from machine was reduced to 273 bushels of cleaned wheat and 224 bushels of oats from machine, to 164 bushels of cleaned oats. The wheat was of standard weight, but the oats as they came from the machine weighed scarcely 25 lbs. per bushel, and when cleaned, they averaged but 28 lbs., so while there were 164 bushels of measured oats, there were by standard weight only 146 bushels. Of course a good deal of this shrinkage may be accounted for by the light crops, the "white caps" in the wheat and the blasted grains of oats; but a good machine should do much cleaner work. The cost of threshing the wheat must be therefore recast, on the basis of 273 bushels. And to the total cost, before fixed at \$27.91 must be added \$2.00, for fanning and re-sacking the wheat. This makes \$29.91, or very nearly 11 cents a bushel—over 13 per cent. of the value.

Manifestly, the threshing-machine and its operators were paid much more than their fair share. Their earnings for the day are shown above, as \$21.12, without expense beyond the wear and tear of the machinery. Allowing six dollars for the labor of the three men (and I believe two of them actually received less) there remains over fifteen dollars for the day and a half, or less, of the time and use of thresher and engine. Supposing the investment to represent \$1,500, and to be able to work at least fifty days in a season (it usually would do more), this compensation is excessive. The rate of charges should not exceed 2 cents per bushel for oats, $2\frac{1}{2}$ cents for wheat and 4 cents for rye. At such rates the thresher would do a better business than the grain grower, unless the latter had an uncommonly good crop; and the heavier the grain, the cheaper the machine can afford to handle it. Here then is the first point at which to draw a lesson in machine-threshing: Insist upon clean work, leaving the grain fit

for market, and pay less for this service; a little more than half present rates is enough.

Cost of Selling. The wheat, threshed late in July and recleaned early in August, was well dried and safe to send to market during the latter month. The question then arose, how to dispose of it. In old times the grain could be taken to a neighborhood mill and exchanged, in bulk, for family flour in barrels, at the rate of five bushels of wheat to the barrel of flour. The grower would also receive one or two bushels of offal, an item worthy of mention. This allowance of wheat (300 lbs.) made the flour (196 lbs.) and well paid for the barrel and for the milling. By the new process it takes less grain to make a barrel of flour. We set apart five sacks, or $12\frac{1}{2}$ bushels of wheat, for seed, and prepared $260\frac{1}{2}$ bushels, standard weight, to be sold. This, we thought, should procure us the 50 barrels of flour wanted, and allow ten bushels of wheat to pay the costs of the exchange. The wheat was offered to the mill from which we buy flour, but they would not take it! They would not even look at a sample! Under the new order of things, the middle-men must be brought in. If we wanted our wheat to go to the XXX mill, we should send it to commission merchant A., who would sell it to the jobber or broker B., of whom the mill might buy it, both A. and B. taking heavy tolls on the wheat. We wanted to haul or send it directly to a mill, but, after canvassing the matter fully, found that was impossible and we could only get our grain to mill by the new and expensive route. So bags were hired to ship in, at two cents a piece, and the wheat sent to a reliable commission house in the city. Here are our returns:

Sold 156 bushels at 79c.....	\$123 24	
“ 90½ “ “ 81c.....	73 30	
	<hr/>	\$196 54
Charges, Freight.....	10 94	
Drayage.....	3 00	
Measuring.....	1 48	
Bags, use of.....	2 00	
Commission, 1½c per bushel..	3 70	
	<hr/>	21 12
Net proceeds of wheat.....		\$175 42

First note, that although 260½ bushels of wheat, weighed on a standard scale at time of shipment, was what we sent, we get credit for only 246½ bushels sold, and this at a further cost of over 8½ cents a bushel for the selling. The cost of hauling wheat from granary to nearest depot has not been added, but our wheat has now cost us 20 cents a bushel, since the bound sheaves of ripened grain were gathered together in the field.

Here is our second lesson: Other people are getting more than their share of our wheat. Too many men handle it, between farm and mill, and at too great a cost. Referring to the charges above; the freight was twice as much as it should have been, the charges for drayage and bags may not have been excessive, but the “measuring” was simply extortion. And the commission? although a cent and a half a bushel seems reasonable, is not one cent as much as this traffic will bear? Plainly, the cost of selling the grain should be reduced.

Milling. From the \$175.42 received, net, for our wheat, the cost of threshing was paid, \$29 91, and there remained but \$145 51. With this we went to the mill to buy our flour, and although here fortunate in securing the wholesale prices, \$5.25 per barrel, delivered, our money would only buy 27¾ barrels instead of the 50 barrels we needed and raised the wheat for. The wheat credited to us, as sold, would make fully fifty barrels of flour and pay all expenses of milling. This wheat, laid

down at the mill, did not cost the miller over \$205. But we had to pay him for the flour it made, \$262.50, a clear profit of nearly thirty per cent., on the transaction. With the money paid the miller for the 50 barrels of flour, he could buy 320 bushels of wheat, at his mill, from which he could make 64 barrels, and by the roller process, probably 70 barrels, and pay all the costs of the making. Lesson number three: Is it not evident that mill and miller are getting more than their share of our wheat for their part of the work done? And, curiously enough, the railroad which charged \$10.94 to carry our wheat, in one hundred sacks of 150 lbs. each from the farm to the city, only part way to the mill, asked but \$5.00 for bringing fifty barrels of flour, of 225 lbs. each, a greater distance, from the mill to the farm.

This is but a plain statement of the facts. To such unreasonable costs and losses, the grain growing farmers of Maryland are subjected every year. The Agricultural College farm tried to raise wheat enough to make its own bread, or fifty barrels of flour. It succeeded and in July last, the harvested grain, sufficient for that purpose, stood in the field. But such are the present methods of trade and milling that in order to convert this July wheat into its equivalent August flour, \$117.00 in money had to be added to the net proceeds of the grain as sold.

It is substantially true, that the conditions which now control his business and prey upon it, force the Maryland farmer to produce wheat enough for two barrels of flour, in order to provide his family with one.

HENRY E. ALVORD.

Note. This paper was begun as the record of an experimental inquiry into the actual cost of threshing, believed to be generally under-estimated. The discussion has been extended to cover other points, but it is hoped all may claim a place in the appendix to this Station report, under the head of "useful agricultural information."

MARYLAND AGRICULTURAL EXPERIMENT STATION.

THE ANNUAL FINANCIAL REPORT, 1888-89.

*The Maryland Agricultural Experiment Station in
account with the United States Appropriation.*

1889.

Dr.

To receipts from the Treasurer of the United States,
per appropriation for the year ending June 30,
1889, under Act of Congress, approved March 2,
1887..... \$15,000 00

1889.	CREDITS.	LED. PAGE.	CR.
June 30. By salaries.....		204	\$6,285 00
“ labor.....		215	1,970 28
“ supplies.....		229	1,219 96
“ freight and expressage.....		240	404 64
“ postage and stationery.....		244	353 54
“ printing.....		248	855 52
“ library... ..		252	246 49
“ tools and implements.....		256	310 57
“ scientific instruments.. ..		262	122 73
“ chemical apparatus and sup- plies.....		266	78 40
“ furniture.....		272	145 46
“ general fittings and fixtures..		274	493 07
“ fencing and drainage.....		283	176 47
“ live stock.....		286	15 00
“ travelling.....		288	528 55
“ incidental expenses.....		292	40 00
“ laboratory fittings.....		294	810 03
“ horticultural supplies.....		296	279 26
“ buildings and repairs.....		277	663 58
			----- \$14,998 65
June 30. Balance unexpended.....			1 35
			----- \$15,000 00

I hereby certify that the foregoing Statement is a true copy from
the books of account of the said Experiment Station.

(Signed :)

W. HORACE SOPER,

Treasurer.

SUMMARY OF STATION WORK,

FOR THE YEAR 1889.

HORTICULTURIST'S REPORT, (pages 26 to 66.)

Tomatoes—a. *Variety Test.* 60 varieties; field culture.

Conclusions: 1. The larger the fruit, the more cells.

2. The more cells, the more solid flesh to seed and pulp.

3. The larger fruit has the less seed, proportionally.

4. The varieties with larger fruits, the heaviest bearers.

5. Most promising for general culture: Ignatum, Paragon, Favorite, Belle, Fulton Market, and New Jersey, (page 33.)

6. Earliest varieties, (1889,) Conqueror, Earliest of All. (Salz.) and Alpha. Bermuda and Advance, the next.

b.—Fertilizer Test, page 43. 12 plots; 14 varieties per plot; 10 different fertilizers or mixtures; 2 unmanured plots.

Indications: The regulating elements in a fertilizer for tomatoes, (on soil of Station,) appear to be nitrogen and potash. Further trials needed.

Potatoes—a. *Verification of Experiments as to Size of Seed,* page 51. 4 varieties on two (2) acres.

Results: 1. Very imperfect; many casualties, but previous conclusions sustained, i. e., "the greater the quantity of seed-potato planted, the greater the total yield." Page 55.

2. The yield of merchantable tubers correspondingly greater.

3. Very large tubers and small cuttings are unprofitable.

4. The most profitable seed, a whole potato, about egg size.

5. Number of missing and barren hills increases as quantity of seed diminishes.

b.—*Comparison of Northern and Southern Seed Potatoes*, page 56.

Results: Difference in favor of Vermont grown seed, in the products at both Maryland and Vermont Stations. 8 varieties compared.

Vegetables—Notes, page 60. Especially Lettuce, Radishes and Turnips.**Orchards**—General notes, page 66. More time needed for results.

CHEMIST'S REPORT; (pages 67 to 94.)

Tomatoes—**a.** Chemical Composition in general, (page 67.)

- Conclusions:
1. Averaging nearly 96 per cent. water; the tomato cannot be regarded as a nutritious food, but must be valued for its other dietary qualities.
 2. Yellow tomatoes have more dry matter than red ones.
 3. The dry substance of red tomatoes is richer in the more valuable food constituents.
 4. A little more sugar and a little less acid in the yellow than in the red; but not much difference.
 5. Chemical Composition is a poor index to general quality.
 6. In total dry substance and total sugar, the varieties stand in about the same order as given above by Horticulturist.

b.—*Effects of Fertilizers upon Composition*, (page 74.)

- Indications:
1. Potash apparently increases dry substance and the acid, and decreases the sugar slightly.
 2. Nitrates and phosphoric acid apparently increase proportions of water and of sugar.
 3. The sweetest tomatoes on plots with phosphoric acid.
 4. The above are only "indications;" the differences were very slight, and much more work needed to reach conclusions.

c.—*Effects of Weather upon certain constituents*, (page 77.)

- Indications:
1. Temperature seems to affect composition more than rainfall or sunshine.
 2. Yield and ripening also appear to depend more upon temperature, than actual duration of sunshine.

3. Highest water contents closely follows most rainfall

4. Highest sugar contents also follows greatest rainfall.

d.—*Comparative Methods of Determining Sugar and Acids*, (page 73.)

Results: Tomatoes must be examined while fresh, for reliable comparison.

Marls—Description of 26 samples Maryland Marls, p. 80. Table of Analyses of same, p. 83.

Results: Nothing of special value found; all low in phosphoric acid and potash, the latter in insoluble form.

Soils—Description and analyses of 12 samples, page 84.

Results: Nothing of importance. (Soil analysis is usually very unproductive in results.)

Methods—Investigation of Laboratory Methods, page 87. Determining moisture in air-dried feeding stuffs. (Of little interest to others than chemists.)

AGRICULTURIST'S REPORT, (pages 95 to 136.)

Silos—Description of those built at Maryland Agricultural College, and of filling the same.

Ensilage—**a.**—Crop of 1888, page 97. Description of materials; harvesting, storing and feeding qualities.

b.—Ensilage from frosted or frozen crops.

c.—Analyses of ensilage crops and ensilage, page 101.

d.—Crop of 1889, page 100. Description and variety tests.

e.—Cost of storing ensilage, 1889, page 103.

f.—Weighting and general notes, page 105.

Forage Garden—Tests of grasses, clovers and forage plants, page 105. Detailed notes on same and on general grass seeding.

Oats—Variety tests, with 33 varieties, page 122.

List and tables of comparative results, page 120.

Wheat—Variety tests, with 40 varieties, page 123.

Results incomplete and unsatisfactory.

Corn—Variety tests. Table, etc., pages 124, 125.

Results: Valueless, because of unfavorable season.

Fertilizers—*Soil Tests with Fertilizers and Corn*, page 126.

Results: 1. Conditions too unfavorable for definite results.

2. Nitrogen alone gave as good crops as "complete" fertilizers.

Rotation—Description of Plots and Records, to date, page 130.
Stable manure gives best results for the first season.

Seed-Germinator—Test of a nostrum called the Seed-Germinator, page 132.

Result: Its use proved injurious rather than beneficial.

MACHINIST'S REPORT, (pages 138 to 136.)

General—a. Boiler and Coal.

b.—Pump and pumping.

Farm Machinery—*Tests of several Machines and Implements*.
Page 134.

a.—Self-binding Harvester. Deering's All-Steel.

b.—Grain Drill. The Superior.

c.—Potato-digger. Rigby's.

d.—Transplanter. Hand Implement, Park's Planter.

e.—Seed-Sowers. Thomson's and Cahoon's.

METEOROLOGICAL RECORDS, 1889; (pages 138 to 147.)

Tables—a. Comparative Table of Monthly Mean Temperatures.

b.—Comparative Table of Monthly Rainfall.

c.—Monthly Summary of Mean Temperatures.

d.—Monthly Summary of Rainfall, Sunshine and Wind.

e.—Rainfall, daily, for 12 Months.

f.—Sunshine, daily, April to November, inclusive.

MISCELLANEOUS; (pages 148 to 157.)

Sorghum—The Sorghum Field.

Statement of Sorghum Crop grown for the U. S. Dep't of Agriculture, with a few special notes,

Growing Wheat—Losses in Growing Wheat; Cost of Threshing and other Items. Experiences with wheat crop of 1889.

Abbreviations—Explanation of Abbreviations of Names used in Report, page 137.

Financial—Report of the Treasurer, year ending June 30, 1889, page 157.

DIRECTOR'S REPORT; (pages 3 to 17.)

(NOTE: Besides references to most of the subjects above named, this report includes the following:)

Sugar Corn—(page 5.) Experiment planned but abandoned.

Tobacco—(page 5.) Experiments a failure because of bad weather.

Feeding Experiments—(page 7.) Recorded in Bulletin No. 7.

Work of Verification—(page 6.) An important part of Station duty.

Co-operation—(page 8.) Description of attempts made, and of some work accomplished.

Seed Examinations—(page 10.) The work done. General results; seed supply of the State, as a whole, satisfactory.

Improvements at the Station—(page 12,) Description.

Needs of the Station—(page 12.) Statement of same.

Exhibitions and Meetings—(page 13.) This class of Station work described and believed to be useful.

Visitors—(page 15.) Increasing in number and interest.

Reports and Bulletins—(page 17.) List of Publications, 1889.

Correspondence—(page 16.) Increasing in quantity and variety; 1542 letters received and answered in twenty months.



